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THE EFFECTS OF PROTECTION.

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THE people of the United States are this year applying themselves with a concentration very rare in great masses of men to the problem of tariff revision. It is inevitable that in a nation of so fresh and independent a spirit the claims of authority and scientific results should not receive any great recognition; and I, for one, rejoice that the people rely upon themselves and their own judgment and experience, rather than on the theories, however respectable, of eminent writers. We are therefore brought face to face with the question, What has been our experience in the matter? What have been the effects of protection in this country? It is especially interesting to examine the question from a strictly practical point of view, because this is the chosen battle-ground of the defenders of the existing system.

Free trade is an extension of the practice of our daily lives. We each of us buy in the cheapest market what we wish to buy, and sell our wares or our labor where we can get the most for them. I do not make my own shoes, but employ the great length of time which it would take me to make them in doing something which enables me to buy several pairs and other things as well. Instead of making my own shoes (thus, in protection phraseology, "protecting" my own "labor"), I buy my shoes of a neighbor, and the Government does not attempt to prevent me or to tax me for so doing. Even my neighbor does not himself make the shoes which he sells me. He does not undertake to protect *his* labor, but buys of a wholesale house in New York, which in turn buys of a Lynn manufacturer. The result of all these complicated transactions going to give me a pair of shoes is, that I get them at an equivalent of a very moderate amount of work, instead of by a great deal of direct exertion and personal sacrifice. So, too,

the citizens of Chicago do not attempt to raise their wheat in their own "back yards," but send their money into distant parts and buy it; while, on the other hand, the farmers of whom they buy do not attempt to make their own clothing, their furniture, or even their own flour. They buy them at Chicago. They do not think it good economy to expend $100 worth of their own labor for what costs but $10 in Chicago, but wisely prefer to use it in creating what will bring $100 in Chicago. So, too, rising in the scale of comparison, Iowa and Kansas do not "protect" themselves against New York and Massachusetts, nor do they attempt by legal means to "foster industries" which exist in the latter States. The national Constitution, fortunately, forbids such a course; and, as a party, the protectionists have not yet taken it on themselves to say that a "protection" policy would be for the advantage of the granger States as against the manufacturing States. But the moment we come to that imaginary line known as the national boundary, this simple and beneficent process ceases. The farmers of Manitoba would naturally buy their clothing, furniture, tools and machinery, and much of their food, at Minneapolis and St. Paul. The merchants of those cities would like to sell to the Manitobans, but the two Governments prevent it. Only last year the Manitobans had a very good potato-crop, while that of Minnesota was a failure; and, on the other hand, fruit was plenty in Minnesota and scarce in Manitoba. It would have been natural to have sold American fruit in Manitoba, and to have brought back potatoes. But no; protection "protected" the people of Minnesota from potatoes that year, and the Manitobans, as they tried to imagine that their superfluous potatoes were apples and pears, doubtless consoled themselves with the idea that they were growing rich, because no Yankees were selling them fruit and taking their money away.

It is useful to recur to these every-day facts of universal experience in order that we may have the great and complicated question before us in its simplest elements. I think the homely illustrations I have used at the outset will lend certainty and significance to the results of a survey of the effects of protection in the larger and vaguer field of our national life. Let the reader keep in mind the consequences which would ensue if I did not buy my shoes of a neighbor—the poor shoes I would have, and the great labor with which I obtained them. Let him imagine the result of the Chicago people attempting to raise their wheat in their own "back yards," or of the farmers of Iowa refusing to buy any cloths or machinery not produced in their own neighborhood. Let him imagine the poverty and want which would prevail in the frontier States if from the moment of settlement they adopted the policy of prohibiting all these importations from

the East, by which they save labor and build up their country. He will then be in a position to see, by analogy, the evils which have followed in the train of protection, even in this country of vast extent and limitless resources. And, on the other hand, he will not fail to see the analogy between the success of that natural system which prevails in the United States, and is practiced by each of us in our private capacities, and the policy of industrial liberty which a few nations have been led to adopt.

The plain primary effect of a tariff and its main purpose, so far as protection is concerned, is to raise the price of the article imported by the amount of the duty. It may be, and to some extent doubtless is true, as claimed, that internal competition afterward reduces the market price. But the primary effect is manifestly as stated, if the article continues to be imported. This increase of price necessarily is borne entirely by the consumers, except in certain special cases (as where the supply market is very small in extent, and where prices would consequently rise very fast with the unfettered demand of the American consumers), since we have no means of forcing foreigners to ship goods here except at the same rates which they would be willing to sell for if there were no tariff. But, of course, it may be that the tariff is so high that the imports practically cease, and the American market is supplied by American producers, though at an enhanced cost over what would have been necessary to pay, with the world to choose from. In this case the consumer, of course, still pays this enhanced price, whether or not, as the protectionist contends, he somehow gets it back. With these few points in mind we will proceed to determine in a few particulars, as nearly as may be what this country has actually paid by reason of our high tariff. It is greatly to be regretted that materials do not exist to make a complete showing of what the protective features of the tariff have cost the people without benefiting the Government; but a few instances may serve as illustrations, and will faintly indicate the enormous extent of that forcible transfer of wealth from buyers to sellers which has been made by prohibitory tariffs.

The average price of steel rails in this country has for the past twenty years been at least $15 per ton more than in England. There has been a consumption of at least 30,000,000 tons necessary to lay and repair our 156,000 miles of railway. More than two thirds of this amount has been bought at home. The Government has, therefore, forcibly transferred about $300,000,000 belonging to one class of American citizens to another class, by laying an embargo on the business of the first in favor of the second.* In some years the demand for steel has been so great

* In the year 1887 Carnegie Brothers & Company, of Pittsburg, manufactured 192,998 tons of steel rails at a cost of $26.79 per ton, and sold them at an average of $37.12½

that rails have sold for double and even treble the natural cost; but still buyers were forced to buy in the home markets. And the reduction in duty from $28 to $17 per ton was accomplished only in the teeth of vigorous protestations that it would ruin American mills and workingmen. I say nothing of the effect of this tax on railroad building and operation in rendering transportation scarcer and more expensive. But it is probable that a line of railway with which I am connected would by this time have been completed and have been paying handsomely but for the $300,000 additional expense of construction entailed by the protection tariff.

Pig-iron enters into articles used in every house and in every business. It is turned into plows, kettles, and stoves, as well as into vast engines, railway material, building material, and fire-arms. Four million and a half tons of this material were made in the United States in 1882 and sold at an average of $22 per ton. In 1880 the market value reached $40, and in 1886 $17. According to Mr. Wilkeson, this material ought to be marketable at $9 per ton easily, and Mr. Vinton does not think its actual value much more. But making an allowance of $12 per ton as liberal, in fact very liberal, we may say that the people of the United States have paid an unnatural price for this product amounting in all to $45,000,000 in 1882 alone; and, assuming that to have been an average year, we may place the enhanced price of pig-iron to the American people for the past twenty years at the enormous aggregate of $900,000,000.

On lumber it is difficult to make an accurate estimate. But assuming the cut of Michigan in 1880 (4,172,000,000 feet) to have been half the product affected, and to have been enhanced in price to the extent of half the duty, which, in view of the enormous forests of Canada, and the great value of our standing pine, is very moderate, the tariff on lumber has cost the people of the United States $8,000,000 per annum. One peculiarity about this tax, or rather levy, is, that it inures to the benefit solely of a few land-owners in Michigan and elsewhere, who were fortunate enough to get the pine-lands when they were worth $2 per acre.

per ton; making a profit of about $1,158,000 on that item alone of their manufactures. For the making of these rails they paid out in wages $778,075, equal to about 68 per cent of their profits. During the same year the same firm turned out about 30,000 tons of iron and steel beams (used in large buildings, bridges, etc.), at a cost of about $28.02 per ton, and sold them at $66 per ton, through a trust; making a total profit of about $1,150,000, which is 135 per cent. of the total expenses and about seven times the sum paid by them to their labor employed on this product. The exorbitant profit thus made at the expense of the owners and patrons of railways and buildings was rendered possible solely by the high tariff (on rails $17 per ton, or about 75 per cent; on beams, 1¼ cent per pound, or about 102 per cent).—Abridged from the speech of W. L. Scott, in the House of Representatives, May 11, 1888.

Labor does not produce the pine, nor does it gain any great proportion of its market value.*

The American people are clothed very expensively. They import about half their woolen goods, and pay thereon an enormous tax to the Government, amounting in 1885–1886 to $35,600,000. The other half of their clothing they buy of domestic manufacturers, and may be assumed to pay an unnaturally high price to about the same extent. We may say, then, that in twenty years the people have paid a bounty of about $700,000,000 to domestic manufacturers and about the same amount in taxes to the Government.

The average wage of Americans is, as is well known, considerably higher than that of the English; yet Mr. Mulhall estimates that the American works forty-nine days in the year to supply himself with clothing, while the Englishman accomplishes the same thing in thirty-four. This result has been brought about by the wool tariff of 1867, which imposed a heavy duty on an article not made or greatly added to in value by labor, wool, and also on woolen clothing. The history of the effect of this duty is interesting and even ludicrous. Foreign wools are needed to mix with American wools to make good cloth. Accordingly, when the tariff was put on wool the manufacturers found that the people would not buy the high-priced product, but bought foreign goods. Then they began to adulterate their woolen goods with shoddy and cotton. But, in spite of everything, the woolen industry was depressed, and the price of wool refused to go up.† Some of them saw the moral; but only the other day I was talking with one who expressed his opposition to the Mills bill by saying, "We do not think it will hurt our business; we *know* it." On being asked if he did not think free wool and a duty of thirty-eight per cent a fair equivalent for the present duty, he started and clearly showed he had no accurate idea of what the

* Soon after the duty was put on pine-lumber the pine was advanced $1 per thousand feet. Seeing this, the men at the camps in Michigan thought it was a good time to ask for a slight increase in pay, inasmuch as the tariff was, they were assured, for their benefit. They asked an increase from $1.50 to $1.75 per day, an increase equivalent to perhaps 5 per cent of the increased profit. Thereupon they were all dismissed. Canadians were imported at $1.25 per day, and were only worked three fourths time at that. Great is "the American system."—"Indianapolis Signal" (Labor paper).

† After the enactment of the high duty on wool in 1867, both wool-manufacturing and wool-growing were very much depressed, owing to the fact that the public would not buy woolens at the enhanced prices. During this period it was very common for the commission-merchant to find that he had over-advanced to the manufacturer. The almost invariable result was a mortgage on the mill-property and a foreclosure. In this way A. T. Stewart acquired mill after mill, but even he failed to make his factories pay, and he is believed to have lost heavily by his woolen-mills. At his death his estate was burdened by a large number of these properties.—From the paper of Rowland Hazard, woolen manufacturer, before the Chicago Free-Trade Conference, November 12, 1885.

bill did provide; but he simply had a vague notion that he had an illegitimate advantage which somebody was trying to take away.

But, in addition to loss of this kind, the maintenance of the protection system has for a number of years resulted in a heavy surplus—a taxation of the people very far beyond the requirements of our Government. This surplus, therefore, must be charged up as one of the costs which the system entails upon the people. For the past seven years this annual absorption by the Government of the annual product has been very heavy. This present year, it seems, the House and Senate have by systematic extravagance succeeded in diminishing the surplus between fifteen and thirty millions. But it is admitted on all sides that the surplus fairly amounts to a sum not less than $125,000,000 annually. This is ten dollars per annum for every family in the United States. The total amount of the tariff taxation is about twice that sum. But if we view the family solely as consumers, and not at all as the recipients of protective bounty (which is practically a correct basis),* we have to add to this cost the enhanced prices of American products, some of which have been mentioned, and of which the Government gets no share. This indirect tax, of which examples have been given, is variously estimated in its total amount. On some articles it amounts to $13 when the tariff tax amounts to $1; that is to say, the consumer pays out $14 in enhanced prices, of which only $1 reaches the Government. On the whole, this indirect levy or transfer (it can not be called a tax) may be estimated to amount to about five times the tariff tax.† It amounts, therefore, to about $100 per family per annum, and, with the superfluous element of the tariff tax, to about $110. While this estimate is largely conjectural, no one who is aware of the increased expensiveness of our manufacturing, and even of our agricultural processes, will doubt that the figure is very large, and perhaps in excess of that named. This, be it remembered, is not a tax on property but a tax on consumption. The poor man pays as much on sugar and rice as the rich man. The carpenter with $2 per day pays nearly as much on clothing as Jay Gould, rated at $30,000 a day; and on no article of consumption or use are the rich and poor taxed in proportion to their wealth, because ninety-five per cent of the poor man's income is required to pay his family's living expenses, while the rich man uses a much smaller proportion for that purpose.‡

* In 1886 W. C. Ford, E. B. Elliot, and Simon Newcomb, statistical experts, reported to the Secretary of the Treasury their estimate of the number of persons in "protected" industries. Their estimates vary from 4·7 per cent to 5·2 per cent.

† I believe this is Mr. Wells's estimate.

‡ It is a frequently made reply to considerations like the above that, though protection

If the foregoing estimate is well founded, it is clear that very serious effects must be found both in the general state of the people and in that of various industries. Let us, therefore, make some general comparisons between this country and the greatest of those nations which have adopted a free-trade policy, and then survey as far as practicable the several effects of high tariffs on the laboring, farming, and manufacturing classes. Such a comparison must needs be more than fair to the United States, because they are growing rapidly in every respect, while England has more nearly reached a stationary state.

The total wealth and annual product of this country and England (applying that name to the United Kingdom of Great Britain and Ireland) are given as follows: *

	1870.		1880.	
	Total wealth.	Wealth per capita.	Total wealth.	Wealth per capita.
United States	$34,379,640,000	$899	$46,145,700,000	$923
England	33,456,680,000	1,065	42,379,200,000	1,210

	1870.		1880.	
	Annual product.	Product per capita.	Annual product.	Product per capita.
United States	$5,098,000,000	$129	$6,901,200,000	$132
England	4,613,000,000	146	5,549,000,000	171

Thus we see that the United States are not only behind England in wealth per capita, but in product per capita; and, still further, that the same relation existed in 1870, but not to the same degree as in 1880; England having made a greater gain during the decade. America gained $24 per capita in wealth during the decade, England $145; while the product per capita in America increased $3, and that in England increased $25.

In wealth per capita, Mr. Mulhall ranks the nations as follows: 1. England; 2. Holland; then France, Denmark, Australia, United States, Sweden, Canada, Belgium, Germany. In annual earnings per capita Australia is first; then England, the United States,

takes from some and gives to others, yet all are Americans—"it is all in the family." This proposition and the other great stand-by, that "foreigners pay the tariff-taxes," I find it difficult to answer seriously. When a philosopher starts out with an inconceivable proposition, it is rather difficult to argue. But we may say, in the first place, that justice has some place in the family as well as elsewhere. Moreover, much of what is taken from the people is, from an economic point of view, wasted: it is used up in sustaining extravagant and old-fashioned processes, unfavorable locations, and the like.

* See Mulhall's "History of Prices," which is generally accepted as a work of the highest authority.

Canada, Holland, France, Denmark, Belgium, Germany, Sweden, in the order named. Mr. Mulhall also computes that the average man in the United States works 113 days to gain his food for a year, as compared with 114 days' work in England; in England he works 34 days for his clothing, here he works 49; house-rent and taxes take 29 and 32 days in England, 30 and 33 days in the United States; and the Englishman consequently has 91 days in the 300 left for other purposes, including savings, whereas the American has but 75. The banking capital and deposits of England are $125 per inhabitant; of Australia, $150; of the United States, $50. The railroads of the United States carried 270,000,000 passengers in 1882, those of England carried 752,000,000; and the slight difference in railway rates is by no means an explanation of the difference. The school attendance in England has increased from forty per cent less per capita than ours in 1880 to about the same. The post-office returns show a greater increase in the use of the mails in England than here. And that faithful index of popular condition, the criminal calendar, shows a steady decrease for a long period, until, in 1885, there was but one conviction to 3,272 persons in England; while America has one conviction to 930 persons, which has been about the rate for a considerable time. And the statistics of pauperism, while not so favorable for England, show a steady and rapid decrease for fifty years, and the ratio of paupers to population is about one fourth what it was in 1840. It would be interesting, had we space, to show the greater consumption per capita of many articles in England than in America, as of woolen clothing, sugar, and rice, the total consumption of food products being about the same per capita; and to show the vast increase seen in England during the past forty years. Suffice it to say that the facts indicate a greater average of welfare in England than in this country. "There are few questions of fact upon which the general public are more misled by our public men than this," says Mr. Gunton, in his "Wealth and Progress"; "but the facts all point to the same result, viz., that the increase in wealth, in proportion to population, has been greater in England than in this country." Lastly, but most important of all to lovers of liberalism, legal equality, and popular government, England has, during the past twenty years, grown democratic "by leaps and bounds," and her vast wealth is certainly known to have been reaching a state of more equal distribution, while we have been erecting an aristocracy of wealth. The explanation of all this reduced to its simplest form is not difficult. England's citizens buy in enormous quantities and in the cheapest markets, and sell in enormous quantities in the dearest markets. The Englishman buys at $10, puts $1 worth of labor on the material, and sells at $15. We buy at $15, put $1 worth of

labor on the material, and sell only to ourselves. The American is not naturally slow, but he can not run with the Englishman while his feet are fettered.

The protection system would obviously not stand for a year in this country were it not for the belief that it results in an increase of wages among our working-people. It is, therefore, especially important to observe the effects of protection upon our wage-earning class. First of all it is to be noted that great numbers of the working-people can not, in the nature of things, be any more subject to foreign competition under free trade than they are at present. This applies to railroad-men, now nearly 700,000 in number; men in the building trades, agricultural laborers, household servants, clerks, professional men, and the like. The numbers belonging to protected and non-protected industries stand about as five to ninety-five, as above noted. The vast discrepancy between the two is not usually taken into account in tariff discussions; but it is instructive, as tending to show that American labor is not in any danger of great displacement by any possible legislation or by any possible competition.

It is a startling fact, of which the application is not obvious, that, while the protected industries have produced more millionaires, perhaps, than any others, the wages paid to workmen in them reach a much lower level than the usual one in wages-paid occupations, and in some cases a most miserably low level. This circumstance is well known, and as such was stated by a number of iron-manufacturers who united in a letter to the late Secretary Manning, in reply to that of the Iron and Steel Association—for there are manufacturers of iron who do not believe that the tariff duty should be three or four times as high as the labor cost of the product:* "The figures of the census show that in the year 1879–1880 the total wages of $9,538,117 paid for mining ore, distributed among 31,668 men and boys, averaged but $301 per working year each, or less than a dollar for each working day. Since that time wages have been again and again reduced. It is a notorious fact that men are working in the mines for eighty cents a day or less." So true is this that, while the cost of living is much higher in this country than in England—for the reason that taxes are there not levied altogether on articles consumed in daily use—the wage-workers receive in many cases about the same in both countries. For example, Joseph D. Weeks, special agent for the tenth census, gives ("Statistics of Wages," pp. 112 and 119) a table of wages paid in the iron-making business in the Cleveland district in England, and in "an establishment in Pennsylvania":

* Letter of J. B. Sargeant and others to Hon. Daniel Manning, December 21, 1885.

EMPLOYMENT.	American.	English.
Keepers, per day	$1 47	$1 61
Keeper's helper, per day	1 35	81
Common laborer, per day	1 00	75
Carpenter, per day	1 23	1 05
Blacksmiths, per day	1 23 and 1 00	1 13

With this we compare American and English wages in non-protected occupations.* Mr. Wells gives from the last census the

EMPLOYMENT.	American.	English.
Carpenters, per week	$14 00	$9 45
Bricklayers, per week	20 00	9 45
Masons, per week	18 00	9 45
Locomotive-engineers, per week	27 00	7 30 to 12 15

average pay of the railroad employés of this country as $450 per annum; and that of the iron-workers as $312. The difference in the degree of skill required is not obvious, nor apparently sufficient to explain the great discrepancy. Lastly, we may cite the statistics brought together by Mr. Gunton in his "Wealth and Progress," and compiled from the concurrent data and results of Giffin, Mulhall, Levi, the United States census, and other great authorities. The comparison is made between several countries, none of whom have a tariff anything like as high as that of the United States. Mr. Gunton thus states the "rise in actual wages" in non-agricultural occupations, making the most favorable allowance to France and Germany, as follows:

	Wages per week.	Increase since 1850.	Hours of labor per week.
England	$7 44	$2 40	60
France	5 04	1 72	72
Germany	3 84	1 62	75
United States	——	(1 87)	About 66

These are very surprising facts, which merit careful attention. The very idea that American workingmen are not in every way in a better position than the English is so strange that we are naturally incredulous. The fact that we have such vast quantities of land, practically free, inviting the poorly paid to settle, would seem to be a sure defense of high wages, and doubtless is such. But there is an explanation, though it is probably but a partial one, in the effects of the tariff. The cost of living has been constantly rising in this country, while that in England has been fall-

* These figures are given for New York and London in the Government publication, "Labor in Foreign Countries," pp. 635 and 1663 to 1667.

ing. The census estimate of the increase in the cost of living in the United States during the thirty years ending in 1880 was 20·17 per cent, while during the same period the cost of articles of common use has fallen about twenty-four per cent. Obviously, the effect of this would be to put the English wage-worker in a constantly better position to demand better wages; while the American, with his cost of living tending more and more to consume his whole income, is in a constantly worse position to demand an increase. It need not be remarked how potent a factor this is, nor need the responsibility of the high tariff for the high prices prevailing be carefully demonstrated. There is not a thing eaten or a cloth worn which does not pay a tariff tax. The wheat is sown after a plow taxed twenty-five per cent in actual extra cost; and is transported on railroads, ground up in mills, put in bags, and sold in stores, all heavily taxed in their construction and maintenance by the tariff on iron. And on many articles, such as clothing, the amount of the tax is scandalously oppressive.

This may or may not explain the failure of American wages to rise to the same extent as English in the non-protected occupations, and, at any rate, there are other causes acting, such as the waste of capital caused by the war, and the heavy immigration of wage-workers. But we need a special explanation for the singular fact that wages in the protected occupations continually fall, even while the general trend is upward. In General Lieb's recent book on the tariff he has a comparative table of wages in twelve unprotected and in twelve protected occupations. In the first, wages rose in the six years following 1880 from ten to thirty-five per cent, while wages in the protected occupations fell from five to thirty-five per cent at the same time. These facts are well authenticated and even "notorious," as remarked in the letter before mentioned to Secretary Manning; but we seldom if ever are shown the reason. I think this can be directly traced to the high tariff. Take, for example, the iron-manufacturing business. In general the American prices are much below the foreign price plus the duty, and importation is impracticable. When the operators have this margin to work on they frequently accumulate a considerable supply beyond the immediate demands of the market. Then, asserting that the market is dull, they reduce wages. The men strike, of course, and the mills close. As production ceases, the price of iron goes up; and, as the foreign iron can not come in, the masters are fairly coining money out of the necessities of the public and the suffering of their own employés. In the course of a few months the latter accept the situation and go back to work at reduced wages. If foreign iron could come in the moment production ceased in this country, the masters would not be so quick to shut down as they are when they make money

out of it; the laborers would be on an equal footing with the masters. But, as it is, the masters have both the public and their employés "in chancery," and have so far been able to resist the otherwise universal tendency to advance in wages. The little circle of events which I have outlined has taken place again and again in Pennsylvania, as the frequent strikes (more frequent, I believe, than anywhere else in the Union) in part testify. These circumstances can not long escape the attention of the leaders of the laboring-people, and from the rising unpopularity of protection among them we may confidently predict that they will not much longer be deceived.*

The depression of American agriculture is well known. In the ten years 1850–'60 the value of American farms more than doubled. In the following twenty years the value increased slightly over 50 per cent. So far as the influence of the tariff is felt in the value of farms, it might be supposed that its operation would be very favorable in the manufacturing States. Yet even here the percentage of increase in value for the decade 1850–'60 is greater than for the twenty years following 1860. All the New England States, save Massachusetts and Rhode Island, show a nominal decrease in the decade 1870–'80, and, even allowing for the 25-per-cent depreciation of greenbacks in 1870, the increase is not great; it does not by any means keep pace with the decade of 1850–'60, during which there was a low tariff. The State of Illinois should be a fair example of what has happened in purely agricultural States. From 1850 to 1860 the increase was 412 per cent; from 1860 to 1880 it was but 250 per cent. The census does not show the mortgages on farms; but, according to the statistics printed in the "New York Times," ten agricultural States have their farms mortgaged for $3,422,000,000 on a total valuation of less than four times as much. It would be surprising if agriculture were not depressed. The same state of affairs exists in American farming as existed in 1840 in English manufacturing, when Cobden and his friends associated themselves to bring in free wheat and to break the power of the landlords. Every tool which farmers use, and nearly every article they consume, bears a heavy tax, just as in Great Britain the high-tariff prices of provisions made it impossible for the manufacturers to pay subsistence wages to workmen. This country naturally manufactures agricultural machinery, and would do so even under absolute free trade, as is proved by the fact that we export it, but the duty on iron-ore and pig-iron makes the price from 15 to 25 per cent higher. Sugar is enhanced in price about 75 per cent by the tariff, and clothing, furniture, and lumber are largely raised in price to

* This explanation was first made, I think, by Mr. Benjamin Reece, at the Free-Trade Conference of 1885.

the farmer. In return, he gets the "home market"; but, inasmuch as he gets precisely the same for his grain, whether it is sent to Liverpool or to Pittsburg for consumption, this does not seem quite compensatory.

As might be expected, the manufacturing interests make a better showing than the agricultural. Yet even in this favored branch of business the percentage of increase in 1850 and 1860 is greater than that between 1860 and 1880; if the rate shown in the former period had been maintained, the manufactured products for 1880 would have been greater in value than it is shown to be by the census by about a billion dollars. It will be observed that these figures are based upon the products of the census years 1860 and 1880, and, as the year of 1860 was one of great depression and that of 1880 of great prosperity, the facts are more strongly in favor of the low-tariff period than is indicated on the face of the figures. Thus, though the manufacturing interest is supposed to be the particular beneficiary of protection, it, too, shoulders some of the burdens of the tariff; and the New York "Evening Post" publishes a list of two hundred manufacturers who favor a reduction. Some industries, such as ship-building, have been nearly destroyed by the high tariff on everything which goes into a ship, and while in 1860 there were twenty ship-yards about New York, there is hardly one left. So with many manufacturers of hardware, which is made altogether too expensive to be readily marketable, by reason of the high cost of the material of which it is made.* And countless derangements and dislocations of industry might be instanced as manifestly due to the tariff. The loss of the carrying-trade has perhaps been sufficiently dwelt upon, but it is still somewhat startling to be brought face to face with the fact that, while in 1860 our ocean marine equaled England's, it at present is about seven per cent of that great country's, and is yearly decreasing. It is calculated that nearly four billion dollars have been paid out on American ocean freights since the war, of which the Americans have got very little. Not only have we lost the carrying-trade, which was rapidly falling into our

* In the "New York Times" of July 18, 1888, Mr. Frank Wilkeson makes a remarkable showing of the effect of the tariff on iron- and steel-making. He computes that pig-iron ought to be produced in Alabama and on the southern shore of Lake Erie at $7 per ton cheaper than anywhere else in the world, and with no reduction of wages whatever. (Moreover, he takes no account of natural gas.) He claims that iron is now made in Ohio and Alabama for little more than that amount, and that the duty of $7 per ton has simply enabled furnaces to stay in Pennsylvania, where every element of cost is very great except the cost of labor, and that the manufacture of iron is thus unnaturally expensive and profitless to everybody. Pig-iron has within eight years sold for $40 per ton, and manufacturers claim that it costs them $15. Mr. Wilkeson says, "The iron-works which will inevitably be built on the shores of Lake Erie will bankrupt every blast-furnace and rolling-mill in Europe." But not so long as a high tariff and combinations protect every manner of extravagance.

hands, but we have thus lost opportunities of export. If an American locomotive is shipped, as many have been, to the Argentine Republic in competition with English engines, it has to be sent in English boats *via* Liverpool, our people standing the disadvantage of the additional charges, time of transport, and interest. Under these circumstances we lose all trade except that gained by great superiority, as in the case of locomotives. Thus the very duty intended to benefit the iron industry reacts. It secures the home market for the manufacturer, but destroys the foreign market, and in times of inactivity, or when the market is glutted by overproduction, there is no opportunity for relief by recourse to a foreign customer. Again, if our manufacturers wanted a machine not to be obtained in America, or raw materials to be had here only at great expense, the Government taxes them at a fearful rate. I am credibly informed that it is for this reason that Mecham & Co., glass-manufacturers of Pittsburg, have resolved to locate in Belgium, where they can get their materials and machines free. So with the Rochester tumbler-works, which, I am also informed, are about to leave an illiberal country. It is thus that we may see one reason for the existence of the great American business colony in Europe. This country pays a premium to many industries to get out of it. Obviously, too, our railway lines lose heavily by the diminished volume of exchanges, just as they would if State or country tariffs were set up. They pay thirty per cent extra for their supplies, and, by way of compensation, are deprived of part of their natural trade. Turn where we will, we find derangements, if not actual loss. Placing, as protection does, everything upon an unnatural footing, liable at any moment to give way, it would be irrational to expect sound and healthy industrial growth. The hysterical fear of some of the protectionists, that English competition and "pauper labor" will "crush" American industry, is rather ludicrous, in view of the history of the American and English competition. If there has been any instance where English competition has not been successfully met in America I do not know it. Indeed, Cobden himself recognized that the United States were the great and only menace to English commercial supremacy. Not to mention others, Mr. Gladstone is quoted as saying, in a public speech: "I will say this, that as long as America adheres to the protective system your commercial primacy is secure. Nothing in the world can wrest it from you while America continues to fetter her own strong hands and arms, and with those fettered arms is content to compete with you, who are free, in neutral markets."

That protection has any effect in fostering "trusts" has been vehemently denied, but so have many other obvious propositions. Protection lessens the number of possible competitors, and conse-

quently makes combination easier. It might be practicable to get up a combination to control production and prices in the United States, and yet be impracticable to form one to cover the entire world. Of the enormous sums beyond a reasonable profit which these concerns have taken from the people we have no accurate knowledge, but the amount even in single cases, such as the sugar trust, is simply vast. It is not argued here that these combinations are criminal. But will it, on the other hand, be argued that we are bound to "protect" them? Are they to combine to force high prices from the people, and are the people to meekly assist in the process?

The central idea of the protective system is to compel our people to buy at home, while allowing them to sell abroad—thus retaining our money at home and adding to it. This is the old mercantile theory so popular during the middle ages. It needs but little reflection to see that such a programme can not be indefinitely carried on. If hundreds of millions of gold are brought into this country, gold becomes cheap, while abroad it becomes dear. There soon comes a time, therefore, when the gold will seek purchases abroad in consequence of its high value there. If we "corraled" all the gold in the world, the only thing we could do with it would be to send it abroad and buy with it. This process has already begun; for, during the year 1887, and much more the year ending June 30, 1888, the balance of international trade was against us. Some protection organs, failing to see the meaning of this, called for still higher tariffs. But that gold is only valuable as it enables our people to buy with it would seem to be axiomatic, however much it is forgotten.

It might be inferred from the above, as it is certainly demonstrated by experience and well understood by economists, that in the long run imports and exports must balance each other, except where, as in the case of England, imports are made to balance incomes derived from foreign investments. But if this be true, then a tariff on imports is also a restriction on exports. Have we found this to be true? Not to rely on such general principles as that all international trade is essentially barter—an exchange of product for product—because payment in gold instead of bills of exchange is too expensive; because freights without return freights are too high; and because, as experience everywhere shows, people learn to buy wherever they sell; not to rely on abstract propositions, let us appeal to the statistics of American and English exports and imports:

	Exports.—Average, 1861-1880.	Imports.—Average, 1861-1880.
Great Britain	£245,000,000	£321,000,000
United States	74,000,000	74,000,000

Passing by such important facts as that we have almost entirely lost our South American trade; that Europe shows an increasing tendency to buy her grain elsewhere than here—I appeal to the following interesting fact cited in one of Mr. Hurd's speeches: In 1870, before sugar was admitted free from the Hawaiian Islands, our exports to them amounted to $590,000; and in 1883, after the sugar kings had been favored, our exports were $3,683,460. In a few years our exports increased sixfold; and Americans now control both the business and the politics of the islands. There is no reason why something like the same proportion should not hold for other countries, especially for Australia, South America, Canada (whose trade has been most senselessly sacrificed), and even for England. But supposing that our whole trade would have increased in only half the above proportion, we find that our exports might have been, in 1887, $2,250,000,000 instead of $750,000,000. Had this been the case, our imports would similarly have increased, and our people would have bought and sold to an advantage of at least a billion dollars more than they have, and would have been at least a billion dollars better off.

Heretofore we have taken a survey, necessarily rapid and incomplete, of the strictly industrial effects of the tariff. Let us now pass to a consideration of its general social and moral effects. We shall find their mere enumeration a serious task. The tendency to undervaluing of imports is well known, and is inevitably inherent in the tariff system; and on this account alone the tariff has been said to make us "a nation of liars." Newspapers are subsidized by its beneficiaries, and false information is systematically spread and groundless fears aroused among the ignorant. Money is sent to districts of tariff reformers to defeat them. Each protected industry maintains a watchful lobby at Washington in its interest. Sham conventions are got up to affect public opinion. In short, it is the old story of privilege maintaining itself by all means fair and foul. Just as Bright and Cobden were denounced as red-handed revolutionists for advocating untaxed bread for the people, so the mildest revenue reformer is now "in favor," in the words of General Alger, of Michigan (who owns several millions' worth of protected pine), "of moving American industries to England." Mr. Cleveland, according to other profound statesmen, "desires to ruin American workingmen." Ludicrous as such talk is, it has its serious side in the debasement of politics and the destruction of intelligent discussion. It is not indeed to be expected that the political discussion of any subject will be remarkable for research or breadth of view. Still, one must be surprised at the manner in which the protection side has been defended by its chief supporters. Mr. William McKinley, Jr., is supposed to be the ablest and most intellectual of the champions of a high tariff,

and his speech on the Mills bill, which was carefully revised, contains some interesting examples of the political and intellectual effects of protection. In one place (p. 32) he asserts that "the working-people of England find that competition with countries employing cheaper labor is too oppressive to bear longer, and are demanding to be saved from further degradation," etc. This, in the face of the marvelous and universally admitted increase in wages and comfort of English labor already mentioned, and also in the face of the conspicuous fact that not a single prominent politician in England champions protection, and that the only protectionists are landlords whose rents are being reduced. In the same speech (p. 27) he attacked the Administration because it bought two thousand blankets for the army of an English firm, when, by paying $606 more, it might have patronized an American firm. Mr. McKinley's theory was that this money should not be saved to the tax-payers, but should be paid, as a bounty, to the American firm. On page 18 he said, "I would not allow a single ton of steel to come into the United States if our own labor could make it." If this is economic wisdom, why should not each State, each county, take the same policy? Mr. McKinley offers no explanation, save that we have "one flag"; but leaves to the imagination what the flag has to do with industrial success. But the *ne plus ultra* doctrine is on page 13: "I would rather have my political economy founded on the every-day experience of the peddler than the professor." In other words, the more we study the subject the less we know about it. Science is a delusion and snare for the impracticable. Ignorance alone is learned. We should not expect to hear from Mr. McKinley that industrial growth, like all organic growth, should be in the line of least resistance and greatest traction, which is the opinion of a sociologist; but we are hardly prepared for his assumption that labor cost is identical with the rate of daily wages. I instance Mr. McKinley's speech, because it is a type. On looking through the other leading speeches against the Mills bill we find the same neglect of facts, the same contempt for science, violence of assertion, disregard of business principles, and coarseness of reasoning. Nowhere do we find any account taken of the history of trade, the prosperity of trading nations, or even the elementary fact that English labor successfully competes with Indian and Chinese labor five times as poorly paid. Indeed, their theory would make this impossible, and therefore it can not be true.

Another very serious indirect effect of the high tariff is that the surplus revenue obtained breeds profligate schemes without number. It seems to be forgotten that the Government of the United States was carried on during J. Q. Adams's administration —one of the best this country has seen—for about $10,000,000 a

year. While our population has only increased five times since then, and our area doubled in extent, the Government spends twenty-five times as much. Extravagance has permeated every department of Government. Perhaps $150,000,000 is wasted in this way every year. Aside from this, however, we have to notice a few of the ridiculous schemes which have been advanced to dispose of the surplus. The worst is probably the proposal to use it to bring up the price of silver, advanced in a congressional speech against the Mills bill.* This was devotion to "labor" with a vengeance. Then it is proposed to use it in educating the South, in defiance of the Constitution and of every healthful dictate of expediency. Another proposition, likewise well supported in Congress, has been to dig the Hennepin Canal, which can not be soberly regarded as anything more than a local enterprise of so poor a commercial character that no private company would think of going into it. And in the improvement of harbors, the supporters of protection have encouraged the waste of enough money seriously to diminish the surplus.† Governor Foraker proposes that the Government buy land and put up public buildings in every town of three thousand inhabitants and over. Then there are innumerable people who want bounties and subsidies for their enterprises. Not to speak of the extravagance and heedlessness of our present pension legislation, we are dangerously near the institution of civil pensions. Lastly, there are schemes to spend any imaginable surplus in fortifications against imaginary enemies and on a navy, which, amounting to nothing with $400,000,000 put upon it since the war, might possibly amount to something if twice that amount were expended. The surplus has also attracted the attention of one of the Labor parties, which thinks the Government ought to "loan" it to "the people." Other protection countries have had the same experience. Canada has been given over to profligate government ever since she adopted a protection policy. Where the Government goes on the theory that the more money taken from the people the better for everybody, it will not be very careful of its expenditures.

One further serious effect to be apprehended, if the protection idea obtains sway, must be mentioned. This is a demand for State and local protection. No logic that makes it advantageous for Kansas to protect herself against England can long resist the conclusion that it would also be well to protect her against Pennsylvania. This idea would the more readily spread because it is obvious that the tariff is a tax on the Western States for the benefit of the Eastern, it being as certain as anything can well be that

* By Congressman Cheadle.

† One harbor within my knowledge has had more spent upon it by the Government than the entire town is worth.

tariff taxes cost Kansas $100 where they bring her $1. Various efforts made by Tennessee and other States to fetter interstate exchange by taxation of drummers, etc., have already been made, but have happily been nullified by the Supreme Court of the United States. Nevertheless, if the idea becomes implanted that this is the best policy, the true way to get rich, the will of the people will in the end prevail. The legitimate and logical outcome of protection is a dissolution of the Union, and the establishment of fifty tariffs instead of one. Although I do not believe that any such thing will happen, it is worth while to point it out to those who, like Mr. McKinley, are logical and thorough-going protectionists, and believe in the speedy and permanent triumph of their idea.

But this is not the American idea. It is not the idea of the Declaration of Independence or of the Constitution. Our fathers did not intend that Congress should have the power to create an industrial aristocracy, that certain classes should be saddled on the rest, and that American citizens should be deprived of the manifest and inalienable right to exchange the fruits of their labor wherever they saw fit. A more liberal spirit pervades that document, and in an important case the Supreme Court, through Justice Miller, has used language clearly implying that protection *per se* is unconstitutional.*

SPEAKING of the lessons that the last twenty years of its activity had given to the Church, the Bishop of Lichfield said, in the opening address of the last English Church Congress: "Twenty years ago we discussed in our Congress the relations of the Bible and science. The discussion has gone on unceasingly, and is likely to continue for a long time to come. But its character and conditions are changing. The time of loud assertion and angry controversy is passing. Timid minds are still staggered by the discoveries of science, but they are beginning to remember that all truth is of God. The honest doubter is no longer regarded as a criminal, but as an invalid. It is even admitted that there may be a considerable religious element in doubt."

* Judge Story (sections 1077–1097 of his book on the Constitution) has lent the weight of his name to the opposite view. But Judge Cooley says ("Principles of Constitutional Law"): "Constitutionally, a tax can have no other basis than the raising of revenue for public purposes, and whatever has not this basis is tyrannical and unlawful. A tax on imports, therefore, the purpose of which is not to raise revenue, but to discourage and indirectly prohibit some particular import for the sake of some manufacturer, may well be questioned as merely colorable, and therefore not warranted by constitutional principles." And in Citizens' Savings-Bank *vs.* Topeka, 20 Wall, 635, the court said: "There are limitations" on all American legislatures "which rise out of the essential nature of all free government. Among these is the limitation of taxation that it can only be used in the aid of a public object. It can not, therefore, be exercised in the aid of enterprises strictly private for the benefit of individuals, though in a remote or collateral way the public may be benefited thereby." It was decided in this case that it was illegal to tax Topeka to pay manufacturers to locate there.

PALEOLITHIC MAN IN AMERICA: HIS ANTIQUITY AND ENVIRONMENT.

By W J McGEE,

OF THE U. S. GEOLOGICAL SURVEY.

I.

DURING the unlettered youth of the race there were no written records from which the antiquity of man can be read. So the anthropologist on the one hand, and the geologist on the other, have sought to construct an early human history from prehistoric relics, and from the formations in which they are imbedded or the fossils with which they are associated. Lubbock divided prehistoric time into four great epochs, viz.: 1. The Paleolithic or rough stone epoch, during which primitive man flourished; 2. The Neolithic or polished stone epoch, during which higher development was reached; 3. The Bronze age; and 4. The Iron age.* These divisions, at first supposed to represent successive eras, are now regarded as representing cultural phases rather than periods of time (in fact, all are found among the present population of the world), and they are accordingly valueless as measures of the antiquity of man upon the globe. The geologist classifies later geologic time as Cenozoic or the era of modern life, divides it into Tertiary and Quaternary (or Pleistocene), and subdivides the Tertiary into Eocene, Miocene, and Pliocene. But no part of the geologic record, as hitherto interpreted, is more indefinite than that of the transition from Tertiary to Quaternary, or from Pliocene to Pleistocene; and this indefiniteness is especially unfortunate for American anthropology, since it was about this period that the autochthon—the primeval inhabitant of the continent—first appeared. It is, indeed, customary to recognize the geologically recent glacial period, during which northern United States was overspread by an ice-sheet extending southward to the thirty-eighth parallel, as the initial episode of the Quaternary; but it is becoming apparent that this period is too long and too vaguely defined to satisfy inquirers for a date of man's origin.

Recent researches in the Great Basin of western America, in the Mississippi Valley, and in the Atlantic slope, have shown (1) that the glacial period consisted of two epochs of humid climate and glaciation (the later comprising two or more sub-epochs); (2) that these cold and wet epochs were preceded, separated, and followed by climatal conditions much like those of to-day; (3) that the intervening a-glacial epoch was of considerable dura-

* "Prehistoric Times," American edition, 1875, pp. 2, 3.

tion; and (4) that the earlier epoch of cold was the longer, though the cold was the more intense and the climate more variable during the later epoch.

The latest researches in the Atlantic slope have shown more definitively (1) that the interval of mild climate separating the two cold epochs was from five to ten times as long as the post-glacial interval; (2) that the cold epochs themselves were brief in comparison with the inter-glacial and post-glacial intervals; and (3) that the earlier and longer epoch of cold was attended by continental submergence reaching four or five hundred feet in the latitude of New York and extending to South Carolina, while the land depression of the later refrigeration was but forty or fifty feet at New York, and scarcely extended beyond the great terminal moraine of Long Island and northern New Jersey.*

During the first epoch of cold and wet local glaciers formed in the Rocky Mountains and in the Sierras, the Great Basin (which these ranges bound) was flooded and the now extinct Lakes Bonneville and Lahontan were formed, and into the lakes great volumes of sand and silt—the lower lacustral beds of Gilbert and Russell—were swept by the flooded rivers; at the same time the northern ice-sheet stretched down into the Mississippi Valley as far as the Missouri River, the land was depressed, and both glacial and aqueo-glacial deposits were laid down; and it was at the same time, too, that the Atlantic coast was depressed until the high hills overlooking New York, Philadelphia and Washington were half submerged, and that the rivers built great deltas of gravel and loam along the shore of the expanded ocean, while the waves dropped shallow-water sediments all over the lowlands. With the interglacial warmth the glaciers of the Western mountains were melted, the lakes were dried, and river-gravels were deposited by the shrunken streams over and cañons were cut into the old lake-bottoms; in the Mississippi Valley the glaciers retreated and the drift-plains became forest-covered; while in the East the land underwent re-elevation, and there was erosion of such extent as to afford a rough measure of the duration of the warm interval. During the later epoch of cold and wet glaciers again formed in the Rocky Mountains and in the Sierras, Lakes Bonneville and Lahontan were refilled—the former to overflowing—and the upper lacustral beds were laid down within them; the northern ice again invaded the Mississippi Valley and formed two or more drift-sheets, together with the peculiar glacial-mud deposit (or loess) into which they graduate, as well as the great terminal moraine stretching from Ohio to Dakota; and in the East the ice again overrode the Adirondacks and the New Eng-

* "American Journal of Science" for May and June, 1888; "Seventh Annual Report of the United States Geological Survey," 1888, p. 537 *et seq.*

land ranges, crept southward to Long Island and northern New Jersey, and heaped up the eastern extension of the terminal moraine, and, as it melted, gave origin to the Champlain deposits of the New England rivers and to certain distinctive aqueo-glacial gravels, of which those of the Delaware at Trenton are the type.

The lower lacustral deposits of the Great Basin, the aqueo-glacial deposits of the Mississippi Valley, and the ancient deltas of the Atlantic slope are correlated, partly because (1) each attests a great and similar climatal episode, because (2) it is evident that each of these episodes was so extreme as to affect the entire breadth of the continent, and because (3) there are no indications among American geologic deposits of other episodes with which these might be confused; the upper lacustral beds of the Great Basin, the upper glacial and aqueo-glacial deposits of the Mississippi Valley, and the glacial deposits of the Atlantic slope, are correlated upon similar grounds; and the harmony among the various records gives cumulative proof of the accuracy of each.

By these researches of the last decade the earlier conceptions of Quaternary history are greatly expanded, and the hitherto obscure relation between the Tertiary and Quaternary is made clear. Where they contain vertebrate fossils, the earlier and even the later of these deposits are, it is true, referred to the Pliocene by paleontologists, while physical geologists refer the entire series to the Quaternary; but this discrepance is one of classification only, and in no way affects the phenomena classified.

The sequence of events made out independently in the three widely separated regions may be depicted as in the accompanying diagram (Fig. 1), representing the temperatures and land-altitudes

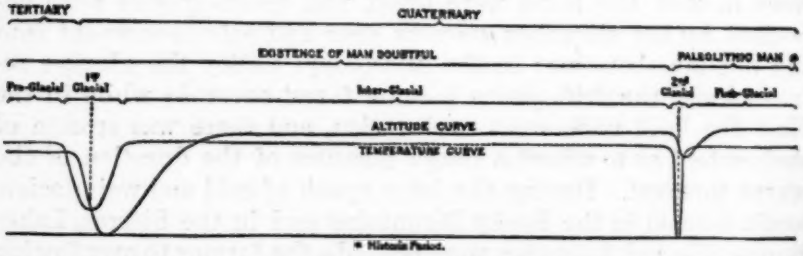

FIG. 1.—GRAPHIC REPRESENTATION OF CLIMATE AND CHANGES IN ALTITUDE OF THE LAND.

during late Tertiary and Quaternary time. By such a chronograph alone is it possible to accurately measure the antiquity of paleolithic man. Marsh has well shown that only long æons can be measured by plant fossils, that somewhat shorter periods may be measured by the records of invertebrate life, and that the vertebrates afford by far the most delicate of the paleontologic time-measures; but the swing of even the vertebrate life-pendulum is

long as compared with that marking the transitory stages of human development, and must give place to the still more precise chronometer afforded by the brief and sharply defined climatal episodes of later geologic time; the human records of diverse regions can only be correlated in terms of these brief episodes; and in ascertaining the relations of paleolithic man to the two best known climatal episodes of the past, it is immaterial whether these be called Tertiary or Quaternary. It is the special merit of the graphic method that it exhibits quantitative relations (for while verbal language is commonly qualitative, graphic language is always quantitative); and in the present case it affords a means of measuring the consistency of the evidence, and of instantly detecting the inconsistent records, of human antiquity.

There are several well-authenticated discoveries of human relics in this country in geologic deposits whose places may be fixed in the graphic time-record forming Fig. 1. Aughey records two chipped implements from the loess of the Missouri Valley, one of them coming from immediately beneath an elephantine vertebra; Miss Babbitt has found great numbers of quartz-chips in a Champlain terrace of the Mississippi at Little Falls, Minnesota, which are regarded by many archæologists as unquestionably artificial; N. H. Winchell records polished stone and copper implements as well as human bones from the same aqueo-glacial terrace of the Mississippi near Minneapolis; Belt several years ago found a fossilized human skull in what appears to be the westernmost extension of the loess in Colorado; Gilbert has shown that the geologic position of an ancient hearth found in excavating a well in northern New York indicates that it was constructed during the closing episodes of the last glacial epoch; a few years since McGee discovered a chipped obsidian implement imbedded in the upper lacustral marls of western Nevada; McAdams notes the finding of a stone axe in loess seventy feet beneath the surface in Illinois; and among the most recent and satisfactory archæologic discoveries of this country are those of two chipped implements of black flint found in Ohio by Dr. C. G. Metz, at Madisonville and Lovelands respectively, in deposits of loess and aqueo-glacial gravel which G. F. Wright has shown to represent a closing episode of the later glacial epoch. But it is in the aqueo-glacial gravels of the Delaware River at Trenton, which were laid down contemporaneously with the terminal moraine one hundred miles farther northward, and which have been so thoroughly studied by Abbott, that the most conclusive proof of the existence of glacial man is found; and it is here, too, that the most satisfactory evidence is obtained concerning the conditions by which paleolithic man was surrounded. It is significant that in all these cases

the human relics were found in deposits representing the closing episodes of the later epoch of Quaternary cold.

There are several cases in which traces of human activity have been reported from older deposits, but in which the discoveries are not so well authenticated. E. g., there is Dr. Koch's well-known record of the finding of mastodon remains in the Osage Valley, Missouri, associated with human implements and traces of fire, in deposits probably contemporaneous with those of the earlier ice-sheet; but the geologic relations have never been clearly made out, and the verity of the discovery has always been (perhaps unjustly) questioned. The finding of a fossilized human bone at Natchez, Mississippi, apparently associated with an early Quaternary fauna, is equally well known; but the attendant circumstances were not such as to carry conviction to the minds of contemporary students. Lewis, also, has described a paleolithic implement from aqueo-glacial gravels at Philadelphia; but he did not personally witness the discovery, and was not certain that the object came from the older (earliest glacial) and not the newer (latest glacial) gravels. It is significant that in all these cases the testimony is internally defective; and, since its acceptance would many times multiply human antiquity as established by collateral evidence (as clearly shown in Fig. 1), it would seem especially wise to reserve judgment upon it.

There are other cases in which human remains have been found in such position as to indicate great antiquity measured in years—e. g., the shell-heaps of Damariscotta River in Maine and St. John's River in Florida, representing a fauna now extinct or displaced; the enormous shell-heap at San Pablo on the Bay of San Francisco, which evidently represents a vast period of building; the shell-beds and superimposed deposits of the Aleutian Islands, which have been shown by Dall to represent at least three thousand years of accumulation, etc.; but in none of these cases is it possible to reduce the historic time-units to definite geologic time-units.

There are still other cases in which human relics have been reported from deposits of considerable geologic age—e. g., in Calaveras County, California, near Golden, Colorado, etc.; but, while the archæologic evidence would seem conclusive in at least one of these instances, it is impossible to confidently transmute the paleontologic record of the age of the deposits into the physical record which alone is sufficiently refined for the measure of human development; and it would thus seem wise to reserve judgment in these cases, also, with respect to the correlation of the deposits as well as to the association of the relics.

Excluding all doubtful cases, there remains a fairly consistent body of testimony indicating the existence of a widely distributed

human population upon the North American Continent during the later ice epoch. The records are not equally decisive, it is true; the artificial character of Miss Babbitt's quartz-chips has been questioned, and they represent a stage of culture widely different from that represented by Winchell's objects from the same deposit; it has been suggested that McAdams's axe may have been an adventitious inclusion; Belt's untimely death prevented final statement of the geologic position of the Colorado skull; the apparently conclusive structural evidence of the antiquity of the Nevada obsidian is opposed by its fresh aspect and modern form; and Gilbert's hearth was not seen by the geologist who studied its relations. Yet, however the doubtful cases may be weighted, the testimony is cumulative, parts of it are unimpeachable, and the proof of the existence of glacial man seems conclusive. But the evidence of man's existence during the earlier epoch of glacial cold is not conclusive; and the evidence of still earlier human occupancy of the continent is not reducible to the terms of definite geologic chronology. Moreover, there is a body of negative evidence which is worthy of consideration. The lower lacustral deposits of the Great Basin have been as carefully explored as the upper, but have yielded no trace of human remains; the oldest glacial and aqueo-glacial deposits of the Mississippi Valley have been explored in Nebraska, Illinois, Missouri, and Ohio, as carefully as the later deposits, but (if Dr. Koch's famous find be excluded) no traces of human occupancy have been found; and, most significant of all, the deposits of the earlier cold epoch throughout the District of Columbia have been scanned for years by a dozen trained collectors and not a single object of human manufacture has been found within them, though thousands have been found on the surface, and though it might be shown that the conditions for savage life were as favorable on the Potomac during this epoch as they were on the Delaware during the later.

The various archæologic discoveries of America display striking diversity in the degree of development exhibited in the relics, which range from the rudest "turtle-backs" to finely chipped flint, polished stone, and even copper; but whether this disparity indicates adventitious inclusion in certain cases—and thus weakens the chain of evidence of human antiquity—or heterogeneity in the primitive population, can not yet be decided. Whatever interpretation be placed upon the questionable cases, however, there is convincing proof not only of man's existence, but of the definite stage of culture called paleolithic, in the later cold epoch of the glacial period. It is indeed obvious that the autochthon must have found birth anterior to this epoch, but the objective evidence of pre-paleolithic art has not been ascertained; and, since the date of origin of a higher culture is unknown, it can only be said that the

paleolithic stage began toward the close of the later cold epoch and extended well toward the historic period, probably overlapping far upon the neolithic stage. Thus the place of paleolithic man in the chronograph afforded by geology is that shown in Fig. 1.

It should be pointed out that the human period of America can not be synchronized with that of Europe, since the geologic chronometer employed abroad is not sufficiently sensitive. It is true that Penck* and others have recently read from the glacial and associated deposits of the Alps a climatal record coinciding exactly with that recognized in this country† (save that the duration of the episodes is less closely measured), and that Mortillet‡ and others have inferred a definite climatal sequence from the

Conspectus of Quaternary History.

United States.			The German Alps.		Northern France.	
			Post-glacial period.	Erosion of valleys; filling up of glacial lakes.		
Second cold epoch.	Cold climate.	Formation of Lake Agassiz clays and Champlain deposits. Terminal moraines and third drift-sheet.	Last glacial period.	Erosion in the central part, moraine building at the periphery, and sedimentation by ice-fed streams without the glaciated districts.	Magdalénien.	Cold and dry. Formation of red alluvium; atmospheric deposits.
	Mild climate.	Relatively short a-glacial interval. Erosion of river-valleys.	Last inter-glacial period.	Erosion of valleys; filling up of glacial lakes; formation of Innsbruck coal, etc.	Solutréen.	Milder temperature; very short relatively. Continuation of terrace formation; retreat of glaciers
	Cold and wet.	Loess passing into second drift-sheet in central U. S. Upper lake-beds in the Great Basin. Moraine-bordered drift in eastern U. S.	Middle (second) glacial period.	Moraine-building; sedimentation by glacial streams.	Moustérien.	Cold and wet. Formation of terraces, great extension of glaciers, clearing out of valleys, and accumulat'n of soil.
Interglacial period.	Mild climate.	Long a-glacial interval. Formation of medial gravels in Great Basin and forest bed in Mississippi Valley. Erosion in eastern U. S.	First inter-glacial period.	Erosion of valleys; filling up of glacial lakes; formation of old deltas and breccias, river alluvium, and lignites with associated deposits.	Chelléen.	Warm and wet. Superior loam, high level alluvium, filling up of valleys, and removal of soil.
First cold epoch.	Cold and wet.	Lower lake-beds in Great B'sin, "Gumbo" passing into first drift-sheet in Mississippi Valley, Columbia formation in eastern U.S.	First glacial period.	Erosion and deposition by ice and glacial streams.	(Not represented.)	

* "Die Vergletscherung der deutschen Alpen," 1882, Tabelle II.

† "American Journal of Science," third series, xxxv, 1888, pp. 462-466.

‡ "La Préhistorique Antiquité de l'Homme," 1885, p. 131.

relic-bearing deposits of central France; but, as shown in the accompanying table, the records are not accordant in their entirety, and can only be reduced to common terms by juxtaposing the earliest recognized Quaternary episode of the lowlands with one of the episodes of the later Quaternary in the mountains. This allocation harmonizes the evidence as to the antiquity of man on opposite sides of the Atlantic, but runs counter to current opinion and appears inconsistent with certain cavern phenomena, and can therefore be set forth as only a possible one. In this as in other cases, paleontologic correlation is incompetent if not utterly meaningless, since the episodes dealt with were so brief that chorologic diversity among the higher animals was unquestionably more important than chronologic variation—indeed, the latest lacustral (and relic-bearing) deposits of the Great Basin, which are referred to the Pliocene upon paleontologic grounds,* appear to have an older facies than the oldest relic-bearing river-deposits of France.

II.

The chipped implements found by Aughey appear to have been dropped on the bottom of the shallow lake or muddy swamp within which the loess was accumulated; since the loess itself consists of glacial mud, and since the basin in which it was deposited was bounded on the north by the Quaternary *mer de glace*, the climate must have been cold; and the associated elephantine remains prove the association of man and mammoth. The relics themselves throw little light upon the habits of their makers, but suggest that they were well advanced in the fabrication of chipped implements. If the obsidian implement from the Nevada lake-beds was really *in situ* (as all appearances indicated), it must have been dropped in a shallow and quiet bay of the saline and alkaline lake Lahontan, and gradually buried beneath its fine mechanical sediments and chemical precipitates; as indicated by the associated fossil bones and teeth, its makers must have been contemporary with the indigenous horse, an elk or deer, an elephant or mastodon, the camel, a gigantic ox, and other extinct animals commonly referred to the later Pliocene; but the single implement tells little of the habits and customs of the people it represents, save that they had advanced far in the art of stone-chipping. Gilbert's hearth was located on the southern shore of Lake Ontario, when it was greatly expanded by continental tilting and obstruction of its present outlet by the later Quaternary glacier, and was buried beneath lacustral deposits when further tilting of the land altered the position of the lake-shore; and since the lake was confined on the north and east by the *mer de glace*, the temperature of the times must have been low and the surface of the water dotted

* "American Naturalist," xxi, 1887, pp. 458, 459.

by floes and icebergs in spring-time, if not all the year round. The hearth itself tells only that its builders knew the uses of fire, and constructed rude fireplaces, but is silent as to their knowledge of water-craft, as to their implements and utensils, as to whether they were hunters or fishermen, and so as to nearly all of their habits and customs. Miss Babbitt's quartz-chips appear (though the geologic relations are somewhat obscure) to represent the site of a primitive workshop or rendezvous on the banks of a river heading in the ice-sheet a few miles or scores of miles up-stream. The artificial origin of the chips has been disputed, and is indicated by their concentration in a certain local stratum and their absence from contiguous strata and other localities rather than by their form—the distribution being apparently explicable only on the hypothesis that they were artificially accumulated, whether or not they were artificially fabricated. The rude chips throw no light on the habits, customs, or environment of the men

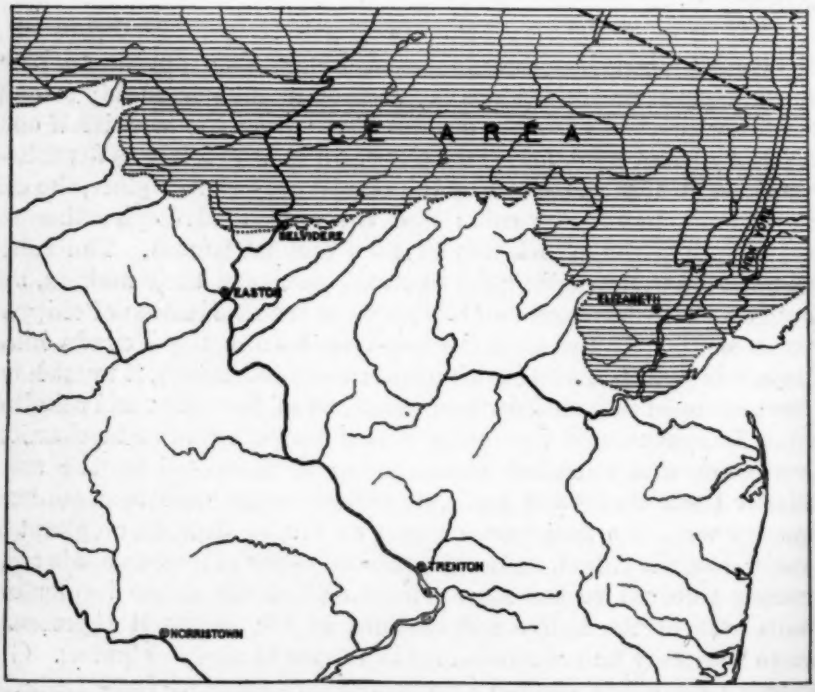

FIG. 2.—MARGIN OF THE LATER QUATERNARY ICE-SHEET IN THE VALLEY OF DELAWARE RIVER.

by whom they may have been fashioned, save that, if artificial, they exhibit the lowest known grade of culture; but this testimony of the quartz-chips is apparently antagonized by that of the polished-stone axe and disk, the copper spear-head, etc., recorded by N. H. Winchell from another part of the same terrace-plain.

The deposit in which the Madisonville implement was found

by Metz was laid down by a turbulent ice-bearing river but a few miles from the glacier's margin. The implement, unlike those recorded by Aughey, McGee, and N. H. Winchell, is of the rude type commonly called paleolithic, and thus indicates primitive customs among its makers; but neither alone nor in conjunction with the similar implement found by the same individual under like conditions at Lovelands does it tell whether the inhabitant of the ice-front in the Ohio valley was hunter, fisherman, or husbandman, troglodyte, nomad, or house-builder; and only the geologic evidence suggests conditions of life approaching those of the modern Esquimau.

When the primitive man of Trenton flourished, the later Quaternary *mer de glace* covered New York and New England, and extended far into northern New Jersey and Pennsylvania. The ice was from five hundred to one thousand feet in thickness near its margin, and overflowed the highest mountains, though they somewhat impeded its progress; the land beneath was somewhat depressed and was tilted northward toward the ice-front; and flooded rivers, born upon and beneath the edge of the ice-sheet, swept into their lower courses and into the sea, glacial mud, sand, and pebbles, while upon their surfaces floated ice-floes laden sometimes with larger pebbles and anon with great bowlders. Among these rivers was the Delaware, which was transformed in its middle course from a constricted torrent rushing swiftly over a rocky bottom (as it is to-day and as it was anterior to the second ice-epoch) into a broad slack-water estuary, tidal probably to the mouth of the Lehigh. This estuary found its source at the edge of the ice, where now lies the terminal moraine (just below Belvidere); and at what is now the head of tide at Trenton it embouched into a broad, shallow bay. At the ice-front it gathered a harvest of cobble-stones which were washed down-stream and deposited in a series of terraces more than one hundred feet in height and two miles or more in width, extending ten miles down the river; the cobbles growing finer and finer and finally passing into beds of gravel and sand. There, too, the waters became charged with glacial mud—the rock-flour forming the grist of the glacial mill—which was more slowly deposited in the form of fine loam sometimes enveloping the cobbles and abundantly intermixed with the finer gravel and sand as far south as Philadelphia, but most abundantly above Trenton. There, also, the river gathered sand, fine and coarse pebbles, great bowlders, and heterogeneous *débris*, which were frozen into ice-floes, floated gently down-stream, and dropped as the floes melted, equally far southward, but most abundantly where the river embouched into the bay and where the floes lingered longest in the slackened current. These aqueo-glacial deposits extend continuously from the

terminal moraine to Philadelphia. They are most conspicuous in the great gravel terrace just south of Belvidere, gradually diminish in volume and height and even merge into the modern alluvium by which they are in part overlaid between Easton and Trenton, become conspicuous again at Trenton (where they cover an area of fully fifty square miles, and are exposed in every natural and artificial excavation below their maximum altitude in and near the city), and finally disappear near Bristol, though the cobbles are largely dredged from the channel to and beyond Philadelphia. They are in part overlaid by modern alluvium, into which they appear to merge midway between the moraine and Trenton; and they repose unconformably upon the greatly eroded surface of the Columbia formation—the aqueo-glacial deposits of the earlier cold epoch of the Quaternary—notably at Trenton, where they fill a basin lined with Columbia brick-clays and gravels.

By structure, composition, and topographic relations the deposits tell the story, as by their geologic relations they fix the date, of their origin. At Trenton the deposits consist of stratified gravels more heterogeneous than, but otherwise undistinguishable from, those of the terraces into which the terminal moraine merges, interspersed with bowlders up to one hundred cubic feet in volume, the whole imbedded in a matrix of sand and loam. The entire mass is unquestionably water-laid; its continuous bedding is indicative of wave-action, and thus of shallow waters; and the bowlders scattered throughout it are evidently ice-borne. Its structure is shown in Fig. 3, reproduced from a photograph taken in the extensive gravel-pit half a mile east of the depot at Trenton. The relations of these gravels to the subjacent Columbia formation are shown in Fig. 4, also reproduced from a photograph taken at Chambersburg—the coarse, stratified gravels,

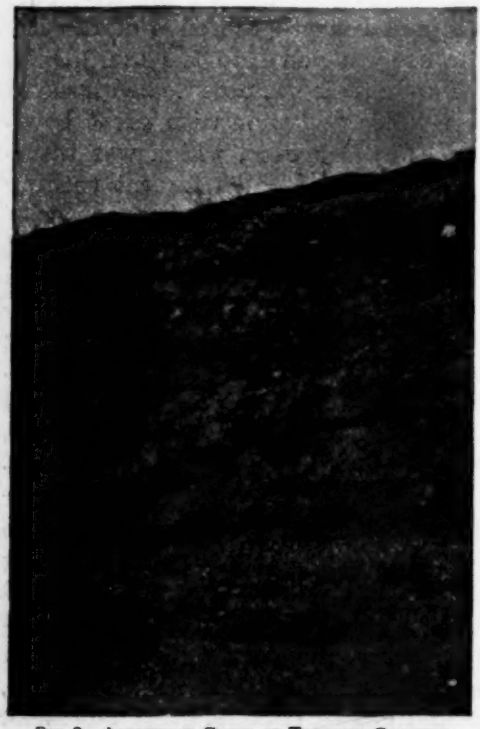

FIG. 3.—ARTIFICIAL CLIFF OF TRENTON GRAVELS.

bowlders, etc., representing the later deposit, and the homogeneous loam passing downward into coarse gravels representing the older formation. The thickness of the deposit ranges from a trifling veneer to forty feet or more; and its surface, where it has escaped erosion, forms a plain inclined gently southward from an altitude of about forty-five feet in north Trenton to tide-level midway between Bristol and Philadelphia; this inclination of the deposit being the measure of the northward tilting of the land during the later ice epoch.

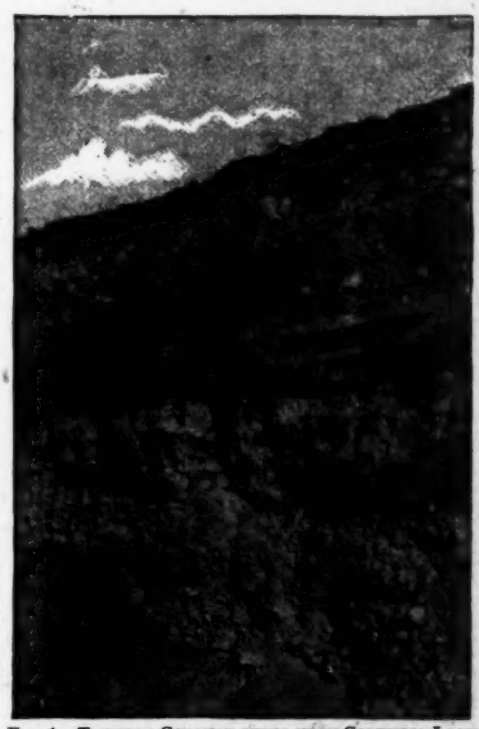

FIG. 4.—TRENTON GRAVELS LYING UPON COLUMBIA LOAM AND GRAVELS.

Within the Trenton gravels two types of implement are found—viz., "turtle-backs" and the rude "leaf-shaped" implements regarded by Abbott as of Esquimau pattern. Both types are chipped from a peculiar argillite which is found in the deposit only as (presumptively) finished implements or as large bowlders. The implements, which occur in such numbers that over twenty-five thousand have been collected by Abbott, are seldom water-worn though frequently weathered, while the bowlders are somewhat worn by water and similarly weathered. It is significant that the "turtle-back" type is found throughout the deposit from top to bottom, but most abundantly in the lower half and in progressively diminishing abundance from bottom to top of the upper half, while the "leaf-shaped" type is found only in the upper half and in progressively increasing abundance upward; it is also noteworthy that both types of implement are occasionally found over contiguous surfaces of the Columbia formation (which were above water-level when the Trenton gravels were deposited), commonly associated with chipped implements of higher type; and it is equally noteworthy that the implements of higher type occur over the surface of the Trenton gravels but never within them, while the ruder implements found within the gravels do not occur upon the gravel surface.

The geologic evidence of the environment of the celt-users of the Delaware River is complete and intelligible: the continuity of the deposits proves that the Trenton gravels were laid down while the northern part of the country was occupied by ice, and while

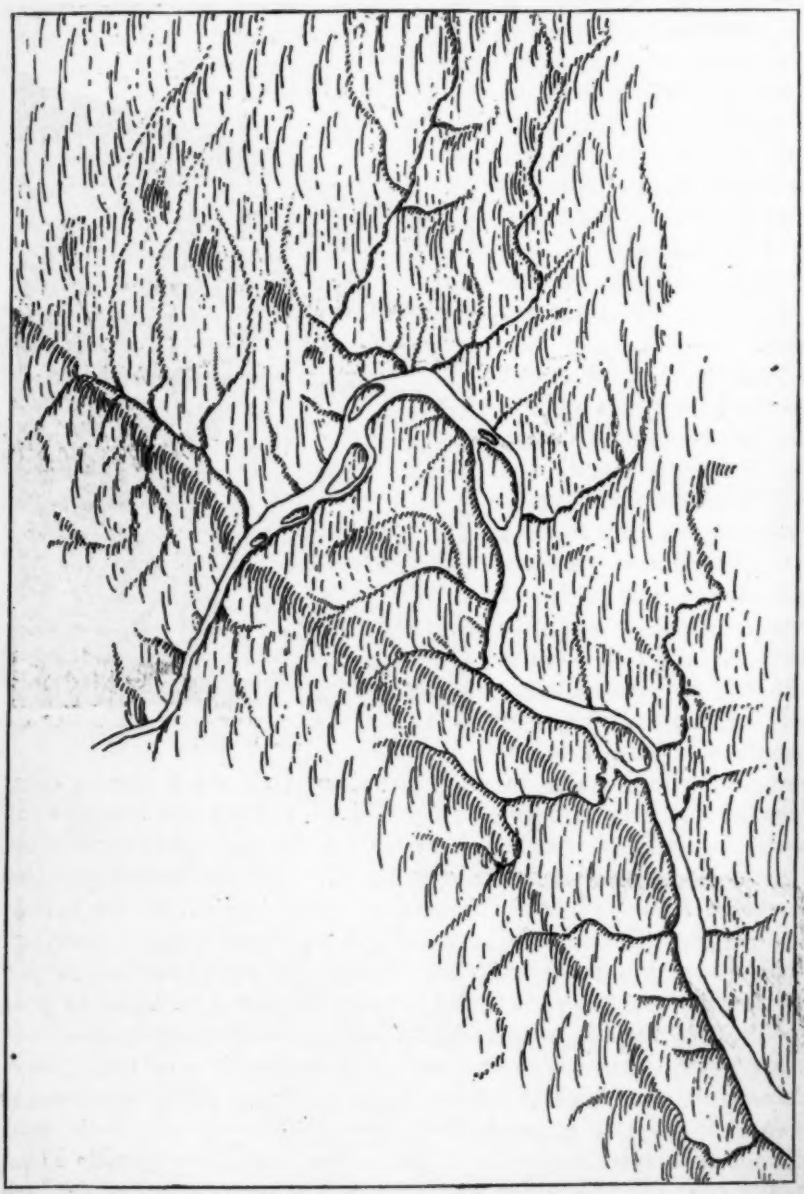

FIG. 5.—STEREOGRAM OF THE PRESENT HEAD OF DELAWARE BAY.

the terminal moraine was forming; their structure and composition prove that they were laid down in shallow floe-bearing waters; their distribution indicates unmistakably the geography

of the period; and this physical testimony is corroborated by the association of remains of extinct or boreal animals (mastodon, reindeer, bison, etc.) with the human relics. So definite, indeed, are the data, that the geography of the period may be depicted

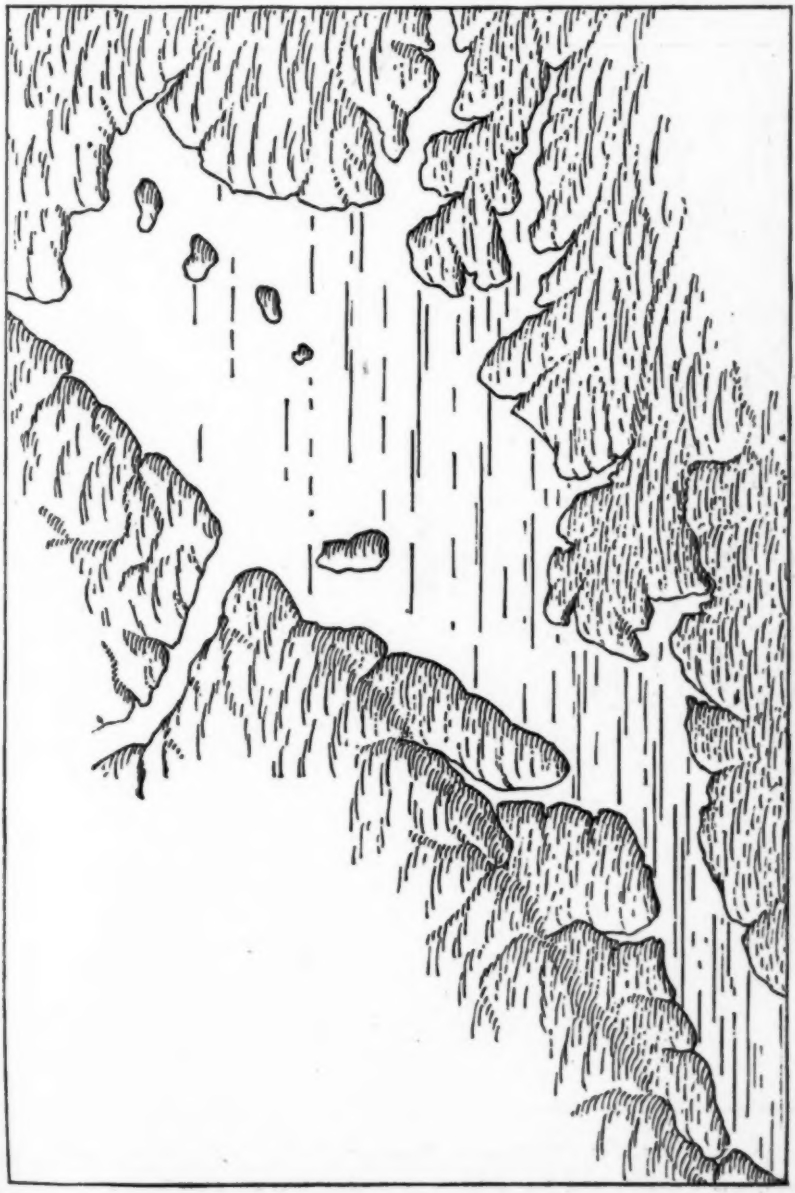

FIG. 6.—STEREOGRAM OF THE HEAD OF DELAWARE BAY IN LATE QUATERNARY TIMES.

graphically. Fig. 5 is a bird's-eye sketch of the present head of Delaware Bay, based upon the admirable topographic surveys of New Jersey and upon personal studies, and represents with rea-

sonable accuracy the general features of the region; and Fig. 6 is a similar sketch of the region as it existed during the Trenton gravel period, based upon the same surveys and upon the shore-lines brought to light thereby, and probably represents the configuration of the earlier period with equal fidelity.

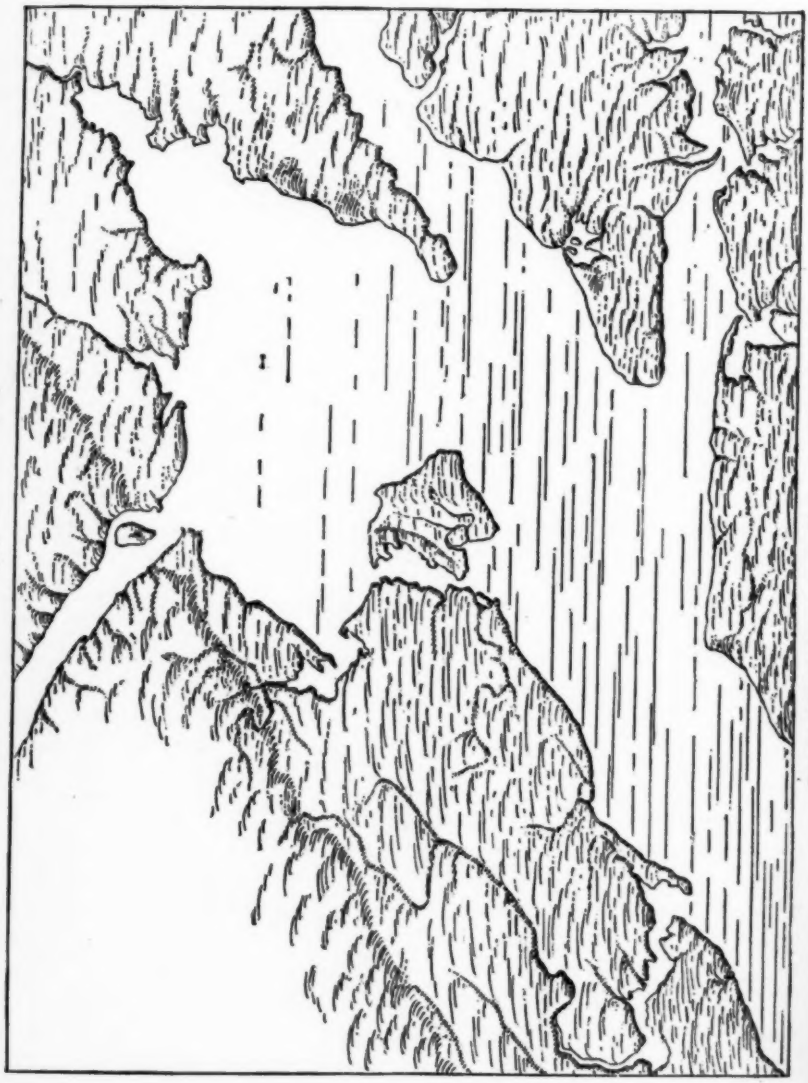

FIG. 7.—STEREOGRAM OF THE HEAD OF CHESAPEAKE BAY.

Fortunately, the Delaware Bay of the later Quaternary has an existing homologue by which conceptions of the local physiography and the attendant biotic conditions may be rendered tangible—viz., the head of Chesapeake Bay, shown in Fig. 7. This estuary is broad and shallow, as was the Delaware estuary during

the glacial period; it is gorged in spring-time with ice-floes formed within its own area and swept into it by its great affluent, as was the ancient Delaware throughout a longer and more rigorous winter; and its bottom is a submerged terrace-plain of loam, sand, and gravel differing from the Trenton gravel only in the less proportion of ice-borne materials within it. In the shoal Susquehanna-Chesapeake estuary grow a great variety of aquatic plants, harboring multitudes of minute animals, which together furnish abundant food for fish and water-fowl, and just as it is now among white men a far-famed fishing and hunting ground, so it was a notable resort of the aborigines, as attested by the village sites about its shores; and since its shallow waters may be waded over half its area and the simplest water-craft outlives the low billows of its storms, the primitive spear-head and stone sinker doubtless underlie the cartridge-shell and leaden sinker of the present, just as the "turtle-back" of Trenton underlies the finely chipped flint of the surface. During the later ice epoch of the Quaternary the climate of the Delaware estuary was less tolerable than that of the present Chesapeake estuary, but other conditions were more favorable to concentration of piscine, avian, and human life within and about it. There the river-breeding fishes were stopped in their instinctive ascent toward former spawning-grounds to increase their kind; there the migratory birds must have ended their vernal journeyings to nest and hatch; there also the flora, forced southward before the advancing ice, must have grown mixed and varied; there the land fauna, pressed by the northern cold and attracted by the forage and carnage, must have lingered and multiplied; and there primitive men must have congregated and dominated over all. It is true but not surprising that the fragile remains of fish, fowl, plants, or even human bones have never been found in the porous and thoroughly leached Trenton gravels, associated with the implements and the more massive bones of mastodon, bison, and reindeer; but the locality was as distant from the ice-front as the arctic breeding-grounds of to-day, and moderately mild climate is attested by the wonderfully abundant implements and the numerous population they represent.

The artificial origin of the "turtle-backs" has been questioned, and their abundance has been regarded as proof of their natural origin; and it is therefore not a work of supererogation to point out that the Trenton gravels are largely wrought for railway ballast, and have been scanned by the thousand tons by eager workmen with the hope of reward before their eyes, and to repeat that the argillite of which the implements are fashioned rarely occurs in the deposit in the form of natural pebbles. Of any hundred bits of argillite selected at random from the gravel-

bank or the collection, ten per cent to thirty per cent exhibit unmistakable traces of design, a somewhat larger percentage suggest but do not prove design, and not more than fifty per cent strike the student as natural, when the individual specimens are examined separately; and when examined collectively the correspondence in form and mode of fracture between symmetric "turtle-backs," "failures," "spawls," "chips," and miscellaneous fragments compels the cautious geologist to question whether any are demonstrably or even probably natural: the series is not from the certainly natural to the doubtfully artificial, but from the certainly artificial to the doubtfully natural.

The "turtle-backs" tell nothing of the customs of the makers, since their function is unknown; whether they were sinkers for nets, whether they were hammers or axes used either in the hand or attached to withes or handles, whether they were used as the *bolas* of the Patagonians, whether they were employed in fishing, first for cutting the ice and then for eviscerating and scaling the fish, or whether they subserved a variety of purposes, remains undetermined. The environment read from geology indicates that the Trenton man was a hunter or fisherman who used and lost the primitive tools of his mysterious craft within the waters rather than upon the land, and thus appears to materially narrow the range of hypothesis as to his activities; but the extravagance in labor indicated by the vast numbers of unworn implements suggests that the rapid modification in environment and occupation accompanying the ice-invasion outran the resulting modification in appliances, and that the implements were really invented on land and were but ill adapted to the new conditions; and the introduction of a new type of implement during the brief epoch of gravel deposition gives support to the suggestion.

So the margin of the cloud enveloping the beginnings of human life in America is slowly lifting. Already there is definite and cumulative evidence of man's existence during the latest ice epoch, with a strong presumption against an earlier origin than the first Quaternary ice-invasion; already it is known that the primitive American haunted the ice front rather than the fertile plain, and must have been hunter or fisherman; already his environment is so well known as to partially elucidate his activities; but the first traces of the autochthon yet found tell of an intelligent being who dominated the animal world as does his descendant, and thus the mystery of man's ultimate origin remains enshrouded as darkly as ever.

HABITS OF THE GREAT SOUTHERN TORTOISE.

By N. S. SHALER,

PROFESSOR OF PALEONTOLOGY IN HARVARD UNIVERSITY.

IN a recent paper published in "The Popular Science Monthly" for February, 1888, I called attention to the effect on the soil produced by various burrowing animals. At that time I had not seen the work done in the under-earth by the *Gopherus Carolinus*, the largest of our North American tortoises, a creature which, on account of its peculiar habits and the geological effects which it brings about, is worthy of an attention which it has not received. It is a well-known fact that land-tortoises are particularly abundant on the American continent. Though found elsewhere, and once extremely abundant in other lands, they are now most plentiful and of largest size in the Americas, and the Galapagos Islands, off the western coast of South America. The greater part of these creatures have the habit of spending the most of their lives on the surface of the ground, only resorting to the under-earth for occasional shelter or during the annual period of rest or hibernation. The gopher, on the other hand, has developed the habit of underground life to such a degree that it may fairly be reckoned as an essentially subterranean form. The greater of our Southern species, and the one to which I shall devote this paper, dwells for the greater part of its life below the surface, only coming occasionally from its burrows. It appears to be by far the largest species of our vertebrates which is normally subterranean in its mode of life. The region at present occupied by this species is narrowly limited; it includes, so far as I have been able to find, only the southernmost part of our Gulf States, the southern portion of South Carolina, and the seaboard region of Georgia, Alabama, and Florida. Within this considerable area it is limited to the regions of the sand-plains, for in those districts alone does it find the soil suited to its peculiar habits.

The gopher, it should be noted, is of considerable bulk, having in adult specimens a length of fifteen inches or more, a width of about twelve inches, and a thickness from the breast to back of from eight to twelve inches. At first sight of the creature, it seems as if its form was totally unfitted for underground movements. The front of the animal is very blunt, and calculated to oppose about the maximum of resistance to movements through the earth. The fore-limbs are not to any degree specialized for grappling with the earth which has to be moved to form the burrow, and the head does not differ from that of our ordinary

turtles and tortoises, which is fitted for grasping prey and not at all specialized for use as a shovel or digging instrument. A very slight examination of the sandy woodlands which are principally occupied by this creature will, however, convince the observer that the gopher, though selective processes have not helped him in his arduous task, is by dint of sheer strength and admirable persistency capable of doing work of singular magnitude.

The traveler in Florida may notice even from the windows of the railway-train that all over the surface of the soil in the pine-woods lie little heaps of sand which contain about one half a cubic foot of material which has been thrown upon the surface since the last period of rains. Sometimes there are only a dozen or two of these heaps to the acre, but they often amount to as many as two hundred or more in that area. Where they are few in number, we may remark that they are distributed in a tortuous line. Where they are very plenty, these tortuous lines intersect each other in such varied directions that no order in the distribution of the hillocks is discernible. Closer observation will show that these heaps are thrown out upon the burrows formed by the gophers. At first it might be supposed that they represented the points of entrance or exit of the subterranean passages, for it seems possible that the soft sand has fallen down over the opening so as to conceal its original position, and thus give the accumulation the aspect of a mere heap; but if the student takes pains to dig down into these little mounds, he will find that they do not communicate directly with the burrows. It is generally impossible to trace in the loose sand the manner in which they have been thrust up to the surface.

A little careful searching will show the way in which these curious mounds have been formed. Here and there, but rarely perhaps in one amid a hundred of these mounds, we find the place where the reptile entered the ground. This opening is at once seen to be quite separate in character from the mounds which first attract the eye. It consists of a clearly defined tunnel, the sides commonly somewhat smooth and compacted by the energy with which the body of the creature has been driven through it. The passage inclines steeply downward, descending at the outset at an angle of from 20° to 30°, then turning at the depth of two or three feet to a more horizontal position. On the surface, a little beyond this entrance, is a heap of *débris*, which consists of the sand taken from the passage. A few feet in from the opening, the passage appears to be closed by loose material which was not ejected from the mouth of the tunnel. Although I have been unable to catch these tortoises at work, I have succeeded by tolerably safe inferences in tracing their method of operation. When they

begin the burrow, they endeavor at once to penetrate downward to the level in which they obtain their food. At the outset they manage, by frequently backing out of the passage, and thrusting the earth behind them in their retreat, to clear a considerable opening. When they have advanced a few feet in the excavation, they cease to discharge the material excavated in their advance, but thrust it behind them, and leave it lying in the chamber, which it entirely closes. With this storage-room provided, the gophers are able to advance through the earth for the distance of some yards; but as the earth compacted by its own weight, by the pressure exercised through the expansion of roots, and the action of the rain, occupies less space than the same material loosened in the progress of the burrow, they soon become hampered in their movements. They then turn toward the surface and continue the excavation upward until they have attained very nearly to the open air. They then use the great strength which they clearly possess to thrust a quantity of the burrowed material upward until it rises above the surface in the form of a cone, and by the space in the burrow thereby gained they are able to go a few feet further in their tortuous line of advance, when they must again seek to discharge a portion of the earth in the manner just described. So the creature proceeds in its devious underground way, coming near the surface and pushing out a portion of the sand at intervals of from two to five feet in its path. In this manner it appears to journey at times for a distance of hundreds of feet before it again has occasion to come to the open air.

For the greater portion of its journey, the path of this creature seems to lie within two or three feet of the surface, that being the level in which it finds the roots which afford it food. It appears, however, from the points at which they emerge in the railway-cuts, not unlikely that they occasionally penetrate to the depth of six feet below the top of the soil. Although they plentifully occur throughout a region having a superficial area of nearly one hundred thousand square miles, they appear to exercise a considerable choice as to the ground they inhabit. They demand, in the first place, that the water-level shall not be within a dozen feet of the surface, and that the material they traverse shall be a very open-textured sand. This is probably because in the rainy season any considerable rise in the level of the ground-water would be destructive to them; unless they could quickly escape from their burrows, they would be drowned. It is often possible, through this habit, to determine in an approximate way the depth of the Tertiary beds of clay and other indurated materials which at many points lie near the top of the sand which envelop the surface in the Southern States. Where these beds,

too compact for the uses of this creature, come within a short distance of the surface, they avoid the ground.

The geological effects of this creature in the district which it inhabits are considerable. In a region extensively occupied by them, they turn over the earth, to the depth of some feet, with amazing rapidity. On selected areas chosen to represent the work done by these animals I found that the number of hillocks varied from fifty to two hundred to the acre, and that the heaps contained an average of rather more than one fourth of a cubic foot of sand when reduced to the measure of compactness which it occupied when in its original place. I came to the conclusion that it would be safe to estimate that in each year this soil matter thrown up by the gophers on the surface of an acre amounted to an average of fifty cubic feet, the greater portion of which was uplifted from a depth of a foot or more below the surface. At this rate they would completely overturn the soil, for the depth of a foot or more, in about eight hundred years. In addition to the effect produced by the process of throwing out the earth upon the surface, these creatures accomplish a vastly greater amount of subsoiling by continually ascending and descending in the earth, pushing the earth behind them as they go. I am inclined to think that they displace vertically, about the amount of a foot or more, all the sands to the depth of about three feet in the course of less than a century. The result is, that in the regions they occupy there is no distinct soil coating whatsoever; the thin layer of half-decayed vegetable matter, rarely exceeding an inch or two in thickness, lies immediately upon the sands, which are scarcely commingled with the humus material. Although the rapid decay of vegetation in the warm climate of the South may in part account for this peculiarity, I think that it in the main is due to the action of these creatures. This view is supported by the observation as to the character of the soil in places where the gophers have not done their underground work. Thus, where the ground is too wet for their occupancy, we commonly find a thick coating of vegetable matter and a soil which is charged with humus to a considerable distance from the surface. The wet "hammock" or "hummock" lands, which exist as occasional patches in the sandy districts where these animals are plenty, apparently owe in good part their more normal character of soil to the exemption from the overturning of the superficial materials which these creatures effect.

There is another important way in which these gophers have influenced the geological conditions of the districts they inhabit. The sands through which they make their burrows have evidently been deposited by water-action. They were probably originally in the stratified form, but so thoroughly have they been overturned

to the depth of several feet by the burrowing of these animals that no trace of this original structure is shown in the railway and other cuts except where by a rare chance the section is so deep that it penetrates below the level of their migrations. At first sight I was greatly puzzled to find that the superficial sands of Florida, which have evidently been deposited beneath the sea, exhibited no trace of stratification, which is invariably brought about in deposits formed in shallow waters subjected to a strong current action. It was only when I came to reckon on the influence of these creatures in destroying the original planes of stratification that the riddle became plain. So far as I am aware, this is the only case in which a burrowing animal has done so much work as practically to efface the stratification planes in a wide field of sedimentary deposits. It appears to me likely that the absence of fossil remains in these superficial sands of Florida may be explained by the endless stirring of the beds which these creatures have effected. It is evident that in their motion through their underground ways they have exercised a very considerable degree of violence. A fossil which might have remained well preserved in undisturbed beds would, from repeated contact with the strong claws of the gopher, have been broken into fine bits, and made ready to pass into the state of solution. As is well known, ordinary marine fossils deposited in porous sands soon become very frail, and would certainly not resist any such rude treatment as they must again and again have received at the hands of these animals. The railway and cliff sections of Florida, which afford us the only opportunities for a careful examination of the superficial sands, are in positions where they are accessible to the gophers. In an examination of a good many miles of these escarpments, I found only one or two points in which a trace of the original bedding appeared to be distinguishable. It is evidently difficult to account for the unstratified as well as the non-fossiliferous nature of this deposit in Florida without some such explanation as that to which our study of the gophers leads us.

To the student who wishes to ascertain the limits of evolution under the influence of natural selection, the gophers present certain facts of great interest. It is evident, from the foregoing statements, that the habits of this creature are eminently peculiar, and yet there are no manifest modifications of the body which fit its peculiar needs. In shape the animal does not differ in any important way from our ordinary terrestrial species of *Testudinata*, which at most burrow in the earth for a little distance to secure temporary concealment or protection from cold in the hibernating season. All the most evident external modifications of the tortoise are directed to the end of securing protection against as-

sault.* The gopher is singularly exempt from the dangers encountered by the species which normally dwell on the surface, and its needs are totally different from its purely terrestrial kindred. How is it, then, that the form remains unchanged? Clearly the selectionist has to assume either that advantageous variations do not occur, or that there is some controlling element limiting the process of variation which absolutely prevents the accumulation of these chance modifications to a profitable end. Variations do occur in the shape of individuals. They seem to be about as plastic as other vertebrates in this regard. Here we must throw out the idea that the failure to produce advantageous modifications is due to the lack of variety on which selection can work. We are therefore reduced to the question-begging of which many naturalists now avail themselves in considering this process, and are compelled to say that there is a certain rigidity in the organization of the animal which prevents the accumulation of beneficial variations. This explanation is substantially like that of the doctor in Molière's play, who explained that "opium put people to sleep because of its soporific virtue"; but this does not suffice in the present case. It is worth while to note in this connection that, although the habits of the gopher have varied little with their peculiar habit of life, they have invented, as before noted, the very sufficient and ingenious custom by which they discharge the surplus earth from their burrows at the least expenditure of force and time. This peculiar intellectual adaptation appears to me one of the most interesting features connected with the life of this interesting animal.

To the question, sometimes raised, whether in the existing profusion of books and newspapers, making the direct taxing of memory less necessary than formerly, the powers of that faculty may not be depreciated, it may be answered that, though we no longer depend upon the memory as our only register of facts, we still use it more than the ancients did. Our knowledge travels over an immeasurably wider area, we have more to remember, and with continued advancement of civilization a good memory becomes more needful for the work of life. Our general intelligence and powers are improving, and memory is sharing in the general advancement.

* The only peculiar modification of the gopher's shell which can be deemed the product of selection with reference to its peculiar habits is the share-like projection of the plastron or lower shell, which is directed forward, and possibly serves in a slight way to divide the earth at the bottom of the burrow over which it crawls. My friend Mr. S. W. Garman, who has kept one of these creatures in captivity, has observed that the animal, by tilting the body downward at the anterior end, can project this share under the edge of a stone or into the crevices between two boards, and exercise a considerable amount of disruptive power by this process. If these creatures made their burrows in stony ground, it might be possible to conceive the structure as advantageous, but as they work altogether in fine-grained soils, I can not conceive that this curious projection is of any functional value.

EVERY-DAY LIFE OF INDIAN WOMEN.

By Captain RICHARD CARNAC TEMPLE.

ONE of the chief characteristics of Indian domestic polity is extreme subdivision, and the tendency among all classes of the natives of India is toward the social isolation of groups with contracted interests, and the consequent accentuation of minute differences in habits of life. The results of this are what is generally known as "caste," and it is caste that underlies and controls all social matters that are peculiarly Indian. At first sight, therefore, under these circumstances, there can be no such thing as a common method of life among the women of a population which is an ill-assorted compost of wild and savage tribes of diverse origin; of Brahmans and orthodox Hindoos; of heterodox Hindoos and Brahmanists by conviction and birth; of Buddhists, and Jains, and Parsees; of Mohammedans, and Jews, and Christians of long standing; of Aryan and Dravidian races; of aboriginal clans of Aryan and non-Aryan descent; of highly cultivated communities and completely ignorant tribes; of whole peoples within and without the pale of Oriental civilization. But, nevertheless, there exists a standard of life which is Indian, and to which all the varieties of the natives of India are drawn—just as there is a life which is Oriental in the usually restricted sense of that term, habits that are Indo-Chinese, and manners that are European. No one supposes that Norwegian and Italian ladies live exactly in the same way, or that English and Spanish women adopt precisely the same mode of life; but that there is a general line of conduct which is common to all European countries is apparent to every one who observes mankind. So it is in India. And the overshadowing influence to which every true native of the great peninsula unknowingly submits is that wielded by the modern Brahmans through their stanch henchmen, the high-caste Hindoos. In describing, therefore, in very general terms, the aims and habits of an ordinary Brahmani, one can give a fair notion of a life which every Indian woman, however antagonistic her creed and race, is unconsciously led on by instinct, as it were, to imitate, and which is her invariable model.

Habits of life are enormously, if not mainly, influenced by religion, and this leads me to say a few words here regarding Brahmanism as a living and active faith, though it has been the fashion in certain authoritative quarters to look on it as dying, if not already dead. Granting that it is not a proselytizing, in the sense of being a missionary, religion, and granting that its fundamental theory—it is only a theory and not a practice, be it remembered—is, to

parody a well-known saying, that *Hindoo nascitur non fit*, still there can be no doubt that it manages to make more converts by mere assimilation than can any other religion in India by direct missionary effort. This absorption into Brahmanism is becoming, under the *pax Britannica*, day by day, a more important feature in Indian social economy. As surely as the English bring fresh uncultured tribes under their civilizing influence, so surely do they add to the number of the Hindoos; as surely as the iron hand of Anglo-Indian law, by refusing to recognize any difference between man and man, causes the upward rise in the social scale of those that labor to good purpose, so surely is the cause of Brahmanic orthodoxy advanced and its influence widened. I have watched the first process myself in the case of the recruits to our little army of Gurkhas; the wild mountain boy, on joining his regiment, is taught not only his drill, but also the Hindustani language as understood in military circles, and with it his religion, i. e., a smattering of current Hindooism. The second can be seen in progress any day all over India, by any one who will take the trouble to observe the career of a successful handicraftsman or small trader. At first an "outcaste," dealing only in matters of religion with his tribal soothsayer; as he gathers money, he sets up a Brahman priest, and minds the orthodox gods, and at last, when respectable and wealthy, he develops into a full-blown Hindoo; and then, since in all Hindooism ceremonial orthodoxy is synonymous with social respectability, he adopts Hindoo manners to the full; isolates his women, prohibits the remarriage of widows, marries off his infant children in the proper quarters, and practices the thousand-and-one customs peculiar to his adopted religion. Of course, in order to be able to thus attract to itself so many antagonistic principles of custom and belief, the modern Brahmanism can have no hard and fast creed. It has, in fact, no creed at all, properly so called. Nothing in the shape of "I believe in God the Father Almighty"; nothing like the strict Mohammedan formula —*lá iláha ill' illáhu, Muhammadi-'r-Rasúlu'-lláhu* (there is no God but God, Mohammed is the prophet of God). It consists rather of a leading principle, viz., to gather together whatever items of belief may come to hand, in order to develop them in a certain definite direction, under the control of its own priests, and for their benefit; and while the process of development is going on, it naturally ingrafts its own customs on to those it already finds in existence. Herein lies its wonderful vitality and strength, its capacity for digesting anything that it gets into its maw, and its power of resisting internal disruption. The apparently elastic network of caste and family customs that it invariably twines round its victims is marvelously cruel, and so unendurable that revolt after revolt has been made against it; but the result, so far, has been

only to loosen the meshes for a time. Slowly and surely the intangible threads have tightened again, as by degrees the very customs created by the schismatics are adopted by its priests, and made to conform to the general theory—all the harder to resist because it is never formulated. The bulk of the Mohammedans of India, being descendants of tribes converted wholesale in various ways to Islam in days gone by, are still Hindoos in many matters of thought and custom. In fact, if we extract the profession of faith and a few formulæ, it is not at all easy to say, as regards them, where Islam begins and Hindooism ends; in any case Brahmanism overshadows their lives. The Jains, at least that important section of them known as the Saraogis, are separated from Hindoos proper rather in sentiment than in fact; and though the Parsees, Jews, and Christians have greater powers of resistance yet it would not be difficult to show how greatly the all-pervading faith of Hindoostan has influenced them too. Many a missionary could tell a tale of more or less ineffectual battle against the notion of existence of a Christian "caste." Of course, I am not now speaking of the tenets deliberately held by the authorized exponents of the several rival creeds, but of the religious ideas of the unintelligent masses, which are to my mind the outcome of an unthinking reverence for things usually held to be holy, i. e., hagiolatry, whatever be the outward expression of faith. Of such a state of things Brahmanism is pre-eminently adapted to take full advantage, for it presents no bold front to prejudices, and bends no man to its will, but rather puts forth its tender tentacles, gradually draws to itself, and quietly absorbs all things.

I would not have it inferred, from what has been just said, that I hold all the women of India to lead practically identical lives; that the secluded banker's daughter has much in common with the scavenger's wife, free to go where she pleases and to speak to whom she will; or that the worthy spouse of the village Maulavi would not at once flare up and feel highly insulted if told that her life was conducted on much the same lines as that of the Panditani over the way. It would be more than erroneous, moreover, to state that a woman of Kumaun has exactly the same views of propriety as she of Mahabaleshwar, or that the grimy Panjabi has manners similar to the oiled and carefully bathed inhabitant of Madras. All I wish to assert is, that a special way of living underlies all those differences which appear so great to the casual observer, and that beneath the chance-tossed waves on the surface there lie hidden depths of female life which are distinctly Indian, and which can be best sounded by a study of the high-caste Hindoo women.

I can not enter into the details of the life of orthodox Hindoo women. Nothing more, indeed, can be done now than to indicate

its merest outlines, in order to show of what it mainly consists, whither it tends, and how it affects those that lead it. Hindoo exclusiveness absolutely prohibits outsiders from personally observing what I am about to describe, and all that can possibly be done by persons such as I, is to procure our facts as nearly at first hand as practicable. Hence the necessity of explaining briefly what the sources of my information are. Chiefly, then, I have drawn upon matters which have come to me as the first hearer of the tale; partly because I am quite sure that all the facts thus learned are straight from the mouths of trustworthy natives of India, and partly because I should be sorry to be, by any mishap, a misinterpreter of other people's writings. Although I shall not be wittingly guided by any one of them, there are several works of original information, more or less directly bearing on my subject, which all who are interested in it would do well to study. Among these are "Hindoos as they are," written, indeed, by a Christian convert with something of the convert's proverbial asperity toward the followers of the religion he has discarded, but containing much that is valuable to the student; "The Hindoo Family" of Balram Malik, a far superior work to the last, by the well-known Judge of the Calcutta Small Cause Court, who has treated his subject as only he can, that is, in full sympathy with it, and, of course, with complete knowledge; and "The Life of a Hindoo Woman," by the celebrated Brahmani Ramabai, who was driven to Christianity at last by the persecution of her co-religionists. For Mohammedans, there are Dr. Herklot's "Quanoon-e-Islam" and "Notes on the Indian Musalmans," by the wife of Mir Ali Hasan, who was an Englishwoman. And then there are several collections of folk-songs—notably Gover's from southern India, and Grierson's from the north—which, between the lines, contain facts about Indian women that none can gainsay. However, I shall now confine myself to statements based, firstly, on notes supplied me by natives for "Panjab Notes and Queries," which I have edited from the commencement; secondly, to the late Dr. Fallon's splendid collection of "Hindustani Proverbs," 12,500 in number, which I commenced editing and translating in 1883; and, thirdly, to the various collections of folk-songs that I have made and published at different times within the last eight years.

An Indian woman's life in its ordinary course is divided into two clearly defined parts, which are quite distinct, though separated from each other only by the fateful day on which she first goes to take up her abode within her father-in-law's family. Note that it is not called in the Indian languages her husband's family, for that, under the Indian family system, it can seldom be in the case of a bride. Childhood rather than girlhood is the heyday of the Indian woman. Free to play as she pleases, with plenty of

companions, for children galore can hardly ever be wanting in a family which all live together, from oldest to youngest; free to run in and out of the houses of friends, never bothered to learn anything except what she can pick up from the women about her, never worried with caste restrictions, never asked to do more in the way of labor than to help in the house-work, petted by her parents, spoiled by her aunts and uncles, and beloved by her brothers, an Indian girl-child is indeed happy—as children count happiness. And then suddenly the curtain falls. At about ten years of age —earlier in some parts and later in others—our spoiled child is old enough to work in earnest, and so she is packed off, sorely against her will, to join her husband's family, entering it not as our brides enter their future homes, at the head of the female community, but at the bottom. Child though she still is, her childhood is now forever past, and she is turned into a young woman, only too often into by no means a happy one.

At this stage it is necessary to consider two matters, so far as they affect an Indian bride, viz., the practice of infant marriage, and what is known as the joint-family. I need hardly state that the so-called "marriage" of infants is practiced among all classes in every part of India, though of course there are many exceptions to the rule. The term "marriage," as applied to this ceremony by us, is, however, rather misleading. It is in reality an irrevocable betrothal—a bargain not between the infants who are "married," but between those who control them, being often nothing else than a purely commercial contract. It arises out of the theory that a woman is for life under tutelage, and her "marriage" is, therefore, merely a transfer of the right over her to another party, a transfer naturally very frequently made in return for a pecuniary consideration. After this marriage or betrothal, the girl usually remains with her parents, in trust for those to whom she is to be transferred, until the home-coming or going to her husband's house, which may be looked upon as the real marriage, as we Europeans use the word. Until the second ceremony takes place the child-wife is still a child to all intents and purposes, and treated as such, and it is only after it that she in any sense enters on the duties of female life. The family she joins is exactly like that she has left, only it is that of another; to her a vast difference, and one which she never forgets—indeed, it is not unfrequently made painfully apparent to her at every step. What I may call the regulation Indian joint-family is one composed of the *paterfamilias*, all his sons and brothers, and various extraneous relatives, such as nephews, cousins, and wife's kindred, for the male part; and all their wives, in addition to his own wife and daughters, together with a sprinkling of the family widows, for the female part. In this patriarchy there are grades upon

grades, both male and female, dependent chiefly upon age and distance by blood from the head of the family; and as everybody is married in India as soon as the time for it comes, the chances are that the last-made bride is, in the nature of things, in the very lowest place.

In the average Indian family the strictest domestic economy is the rule of life, and the household work is done by the women of the household, not, as with us, by paid servants. Servants there are, of course, in all Indian families, but they are, as a rule, on a totally different footing from the European domestic, being for the most part independent persons with a *clientèle*, for whom they perform certain customary services for a customary wage. The distribution of the daily work, down to that of the most menial kind, lies with the *materfamilias*, who may be best described as the oldest woman in the family proper under coverture, for widows can have no authority. The cooking, as the work of honor, she keeps to herself, but the house-cleaning, the washing, the care of the children, the drawing of the water, the making of the beds, and so on, is done by the less dignified members of the household, as she directs; and whatever is most menial, most disagreeable, and the hardest work, is thrust upon the bride. She is the servant of the very servants, and must obey everybody. It is hardly, therefore, to be wondered at that, after her previous training, it is by no means an uncommon occurrence that she has to be forcibly broken into her new way of life, that she is for ever sighing after the flesh-pots of her father's house, that there are various "customs" which enable her to revisit it at stated times after the marriage, and that the law is often invoked to oblige brides to return to their husbands' families after the customary term of such visits has expired.

Not only is our bride thus turned into a drudge, often unmercifully overworked, but from the day she gives up her childhood to the day of her death—it may be for sixty years—she is secluded, and sees nothing ofthe world outside the walls of her family inclosure. It should always, therefore, be borne in mind, when trying to realize Indian female life, what a very important thing the domestic economy is to a woman; how largely the petty affairs of the household loom upon her horizon. Her happiness or misery, indeed, entirely depend on the manner in which the affairs of the family are conducted. Now, considering that the female mind has for centuries been mainly directed to this all-important matter, it is not astonishing to find that such questions as the proper method of eating and drinking, and of domestic propriety generally—the intercourse, that is, which is permissible and right between the various members of the household, male and female—have long been regulated with the utmost minuteness. To us

who roam the world at will, and whose interests are often fixed far more outside than inside our homes, it may seem remarkable that such infinitesimal restrictions and numberless customs as are found in full swing in an orthodox Hindoo household should be remembered and carried out with the exactitude demanded of the womenkind; but if we consider that these make up their whole life, and that they are called upon to pay attention to nothing else, their capacity for recollecting when to veil and unveil, whom to address and avoid, when they must run away, and when they may speak, ceases to be extraordinary. And regarding these customs of social propriety, I must say that the more one studies them the more one is impressed with their perverted ingenuity. They seem purposely invented to make the unfortunate victim of them as uncomfortable as possible. The Indian woman, isolated from the outer world by custom, is again by custom isolated as far as practicable from all the male members of that little inner world to which she is confined. Free intercourse, even with her own husband, is not permitted her while yet her youthful capabilities for joyousness exist. No wonder, then, that absence of jollity is a characteristic of the Indians generally, for the happy laughter of a home is denied them by custom in the most persistent manner.

Every person belonging to the European races, an Englishman especially, well knows how much common meals tend to social sympathy; how powerful a factor they are in promoting pleasurable family existence, and in educating the young to good manners. There is nothing of this sort in Indian upper-class society. There the men and women dine strictly apart, the women greatly on the leavings of the men, and that, too, in messes of degree, very like those in a royal naval ship. *Paterfamilias* dines by himself, then the other men together in groups, according to standing, waited on by the women under fixed rules; and lastly the women, when the men have done, our poor young bride coming last of all, obliged often to be content with the roughest of the fare.

No imported woman may have any relations with those males who are her seniors. Every bride is such an imported woman, and all the household which she enters, who are the seniors of her husband, are her seniors. This at first generally includes nearly the whole family, and must necessarily for a long while include the major part of it. In all her life she never speaks to her husband's father, uncles, or elder brothers, though dwelling under the same roof, or, to speak more correctly, within the same inclosure, for an Indian house is what we should call a courtyard surrounded by sets of apartments. On the other hand, *paterfamilias* has not only never been spoken to, but technically never even seen, by any of the younger women of his varied household, except those

born within it, though they all dwell under his protection and at his expense. You will perceive, therefore, that the women's lives are contracted to within even a smaller sphere than that limited by the boundaries of the common family dwelling.

What would seem to us to be intolerable restrictions by no means end here. In many places it is not proper for a young father to fondle his own children in the presence of his parents, and highly improper for a wife to be seen holding converse, or appearing unveiled, or sitting down before her own husband, until she has become a mother.

There is another custom regarding which it is useless to pretend that it does not lead to endless misery and family squabbling —the absolute subjugation of the women to the *materfamilias*. The mother-in-law is indeed an awful personage in the eyes of her sons' wives, one against whose will and caprice it is hopeless to rebel. I can hardly describe her power better than by noticing a daily ceremony which symbolizes it. It really amounts to wishing "good-morning," is called in upper India *máthá tekná*, and consists of bowing down to the ground and touching it with the forehead. All the women, except her own daughters, perform it daily to the *materfamilias* when they first see her, and a bride must do it practically to everybody.

An Indian woman's happiness in life immensely depends on her becoming the mother of a son. This at once raises her in the family estimation, which is all in all to her; insures her against the greatest bitterness of widowhood, in case that befall her; and procures her domestic authority should she survive to mature years under coverture. *Materfamilias* is a veritable queen in her own little world, often coercing her husband, commanding her sons, and ruling the rest as she pleases. From what has come under my observation, I have long felt assured that, speak contemptuously of the opposite sex as they choose, lock them up as they may, and treat them as mere breeders of sons as they will, the natives of India are far more henpecked than they care to admit. Outside of their homes the men live a life of their own, untrammeled by considerations of the fair sex; within them they have little control, and it must be borne in mind that it is the women that have come to be such sticklers for the continuance of the state of things I have above endeavored to describe. The remarks just made apply, as above said, to the mothers of sons only. Should a woman be so unfortunate as not merely to be barren, but to be simply the mother of daughters, life goes much harder with her, especially as this is so liable to bring upon her that which (if their songs and sayings are to be trusted) the Indian women dread more than all things except widowhood—the advent of the co-wife. There are proverbs innumerable to show how very badly

co-wives get on, but "a fairy for a co-wife is a devil" exhibits the mutual relation forcibly and clearly as it usually is. And when the rival wife brings forth the long-desired son, the barren woman's cup of bitterness is full, and all her hatred towards him is, to those who know the circumstances, well expressed in that most sarcastic of sayings in any language, "The son of the co-wife." No more words are wanting to the Indians to convey the expression of all uncharitableness.

As to the hard lot of the childless widow, so much has been said elsewhere, and so often, that I do not feel inclined to enlarge upon it, especially as enforced widowhood is not nearly so general as is usually made out by those who would deduce a moral from Indian manners to the glorification of the habits of Christians. It is often not prevalent among classes who conform generally to the customs I have been mentioning, and circumstances make it impossible among many that are not comparatively wealthy; but where it is the rule nothing can be more cruel, and, I feel justified in using the strong term, more revolting. Take the case of the widow from infancy: shorn of all that women value anywhere in the world, dressed in coarse clothing, deprived of her ornamenst, compelled to fast till health breaks down, made to subsist on the coarsest of food, kept out of what amusements come in the way of the rest of the household, forced into being the unpaid drudge of the family, held to be the legitimate butt of the ill-nature of all, considered fit only to amuse the children, openly called and taught to think herself a creature of ill-omen—this being the cause of all the rest of her sorrows—superstition has indeed nowhere else shown more clearly its power to pervert the reason of man. How much the women dread widowhood is exhibited to the full in the fact that to call a woman a widow is to offer her a dire insult, and from her earliest childhood a girl is taught to pray that she may die while yet the red spot of coverture remains on her forehead. In any case the fear of widowhood overshadows the Hindoo lady's life, even though she hate her lord.

However, it is no part of my business to tell a sensational tale, nor do I wish to convey an impression that an Indian woman's life is necessarily all unhappiness. Human nature in her case is as capable of adapting itself to circumstances as elsewhere, and since the ultimate gauge of permanent individual happiness is suitability of temperament to immediate surroundings, many a woman in India must be so constituted as to be quite content with the life she is called upon to lead, and in fact to enjoy it. When a girl is naturally sedate, yielding, and good-natured, of blunt susceptibilities, limited aspirations, and strong religious emotions, she will give in to her mother-in-law, avoid quarelling without effort, follow the course of life laid down for her without demur,

thoroughly believe it to be the only desirable life to lead, find the innumerable restrictions imposed upon her not unwelcome, and become contented with her contracted sphere; and, if those about her happen to be kind, be quite as happy as any girl in the world. But the potentialities for misery involved in her surroundings are enormous, and, where such is the case, to argue that misery is not the frequent result would be to argue against human nature. At all events, the purview of her life is limited to a degree which it is difficult for us to realize. It resolves itself daily into this: the strict performance of petty religious ceremonies, feeding, bathing, dressing, cooking, and household drudgery, all so hedged round with minute regulations as to make each a special occupation, and to these must be added visiting and gossip during her afternoon leisure. How petty that gossip must be can be inferred from the facts already laid before you. Remember that the great majority of these ladies are altogether uneducated, that ever since they have been old enough to observe and think they have been shut out from the world, that they have no knowledge of any person or thing beyond those immediately around them except what they can pick up from their menials, and then you will have no difficulty in understanding that their interests are centered in their jewels and ornaments, their food, their personal concerns and troubles, the peculiarities of the members of their households, and, lastly and chiefly, in what social ceremonies and feasts happen to come their way, the widows being shut out from even these. If a marriage, a death, or a birth among their kindred were the only landmarks in English ladies' lives, we should soon have these occasions erected into as lengthy family ceremonies as they are in India. If the observance of Ash-Wednesday, Shrove-Tuesday, Candlemas, Michaelmas, Lady-day, May-day, and what not of our standard religious and secular feasts were the main opportunities for breaking the monotony of an imprisoned life, how carefully they would be kept, and how anxiously looked forward to! This is why all the innumerable *shankránts, ekádshís, ashthamís, náumís,* and other queer fasts and feasts are so regularly attended to in India. Indeed, female ingenuity has there long ago seized upon the many other opportunities for diversion afforded by occurrences incidental to human existence, and there are ceremonies to be gone through on every possible excuse. No phase of life escapes—childhood, puberty, pregnancy, maternity, widowhood, all come in for a share. The first tying of a rag round a boy's loins occasions a family feast, and so does the first time his hair is cut the first time he puts on the *janéu,* or sign of caste; and so on all through life. Before he is a man he has gone through sixteen sacraments, each a notable occasion in the eyes of his womenfolk. Babies are put through all sorts of ceremonies, on the

first, the fifth, the seventh, the fortieth, and other days after birth. They can not even see the sun for the first time, and, of course, can not be given a name, without a feast being held over the fact. As to the women's special ceremonies, they are just as numerous.

With reference to the rough sketch I have given of what I may term the normal state of things in India, I would again draw attention to the fact that I am far from saying that such is the invariable rule, or from denying that there are whole castes whose women are not secluded, and that many are educated. I feel compelled to repeat that minute and endless variation is the chief characteristic of Indian society, in case it may still be thought that my analysis of a high-caste Hindoo woman's life is exactly applicable to that of every woman one meets in the roads and fields. The fact is, there is no subject on which it is easier to speak to generalities from isolated facts, and it is so wide and complicated that one can hardly make a broad assertion without with perfect truth being contradicted as to the specific custom at any given spot. I merely say that the above description is, as fairly as I can make it, applicable to the life actually led by millions of Indian women, and it is the style of life toward which nearly all of them unconsciously gravitate.—*Journal of the Society of Arts.*

ALTRUISM ECONOMICALLY CONSIDERED.*

By CHARLES W. SMILEY.

THE primary motive of human action has always been the care of self, this being for man Nature's first and greatest law. In his unthinking zeal he has often followed this to a degree unnecessary, and consequently harmful to others. In his savage state, and especially in his primeval condition, where he was subject, like all the lower forms of life, to the law of the survival of the fittest, he could not consider others' interests because they were so antagonistic to his own. Often one of two must starve, and each would let it be the other one; he did not even become conscious that he was so acting for a very long period of time. It was the progress from a being not human to the being called man when sufficient intelligence had accumulated to make him conscious that he could live and let live. That point was also marked by and synchronous with the acquirement of such weapons and such skill as enabled man to procure food enough to make the starvation of some unnecessary. Then the war for the survival

* Vice-President's address before the Economic Section of the American Association for the Advancement of Science, delivered at the Cleveland meeting, August, 1888.

of the fittest, as known to biology, ceased among men. Ever since, so far as there has been a struggle affecting the survival of the fittest, and that struggle continues to the present day in certain ways, it has been of a different sort, and one which must not be confounded with the biologic law of the survival of the fittest. Major Powell has admirably shown how the strictly biologic struggle has ceased in man, but he has not yet shown, as may be, the character of that struggle, largely intellectual, which still works out certain survivals of the fittest.

Having passed from the point where, if he survive, it must be at the expense of others, man began to recognize and to consider the desires of his fellows, and among others he counted not only his fellows, but mythical and supernatural beings. Thus appeared the greatest natural basis of religion. It is not strange, therefore, that religion should have existed from very early times, and that it should have taught its votaries especially to regard the needs of others. Its mission was to teach a race whose ancestors had been absorbed for untold ages in caring only for self, to adapt itself to a new environment by learning to care for the wants of others. In caring for others, the more powerful soon received superior recognition, so it came to pass that supernatural demands took precedence of the rest. When that point had become clear, men were easily tempted to profess to represent the gods in order that they might share the precedence. In this natural way became established the order of duty which was taught by every religion prior to Christianity, viz.:

1. To the gods and their representatives. 2. To self. 3. To others.

Early Christianity must be credited with changing the order of duty to the following: 1. To its one supernatural being. 2. To all others equally with self.

Even under this improved system many people are led to make great personal sacrifices in the belief that thereby they are living the noblest life possible to man; when, in reality, as it is the object of this paper to show, their sacrifices are either useless, or, what is worse, grossly injurious both to themselves and to the supposed beneficiaries.

During all the untold years in which it was a physical necessity to regard self even to the injury of others, our ancestors acquired a predisposition thereto which heredity has brought down the stream of time. As being no longer a necessity, its practice long since became one of the recognized evils of the world. We apply to it the opprobrious epithet of selfishness. There is a better term, and one which does not imply a moral quality, for there may be devotion to one's own interests which should not be so characterized. Egoism is such devotion to one's own interests;

it may be proper and it may be improper. The term does not imply either propriety or impropriety. Let the word self-interest stand for justifiable egoism, and the word selfishness represent unjustifiable egoism.

Egoism, then, was once a necessity, and, while it was a condition to existence, it was justifiable, whatever its effects on others may have been. When things changed so as not to render egoism a necessity, man was still as prone to practice it as before. He was acting under the acquired impulses of ages. It was an extremely difficult thing for him to repress his egoism; it was perhaps even more difficult for him to understand that he ought to do so. And yet the change of circumstances had produced a change in its moral quality. From the practice of self-interest he had passed to the practice of selfishness, and he had so passed unconsciously, for the change was in environment and not in him. The same act that had been a virtue was now a vice. Of course, centuries were needed for this idea to develop and to be disseminated, but at length it came. Although the terms were not in use, the differentiation had taken place. The terms came when needed to express existing ideas.

Long after egoism had differentiated into self-interest and selfishness, came the idea of doing something for others. Man's powers were then so limited that this was not much. Even when he became capable he was slow to discover it and slower to act upon it. Heredity bound him. To loosen him was the mission of religion. Whatever its votaries may claim as to its history and purpose, the one great and overwhelming power that religion has had upon the world is this—it has developed doing for others. It has turned man's attention away from himself to those not himself. A most excellent term to use for this is *altruism*—a term first employed only about fifty years ago by Auguste Comte to signify devotion to others or to humanity. Percy Smith, in his "Glossary of Terms and Phrases," defines it as "the doing to another as one would be done by; opposed to egoism."

Such terms as benevolence and charity have been generally used to cover the idea of altruism, but in the mind of every one benevolence and charity involve the moral quality of goodness. It is of the greatest importance to have a word like altruism which does not imply any moral quality, and which covers all we do for others regardless of the consequences, just as egoism covers all we do for self regardless of consequences or of moral quality.

That mankind has thus far regarded all altruism as good is undeniably shown by the fact that neither the English nor any other language has words to distinguish proper from improper altruism. This distinction has not been well developed. It was early seen that the motives were of importance. If we do something

for others, it should be with a good motive. The act was declared to be of no subjective value unless the motive was lofty, thus: "Do not your alms before men to be seen of them, otherwise you have no reward of your Father which is in heaven." Calling attention thus to motives was doubtless a great advance upon the preceding times. This improved form of altruism was, however, indiscriminate. Nothing was said or implied, in the above precept, as to the character of the persons to whom alms were to be given. Nothing was hinted or thought of the ultimate effect upon the recipient of giving alms, much less of taking steps to prevent any from needing alms. Elsewhere the intimation was that all who were poor should receive, as indicated by the direction "Go and sell all that thou hast, and give to the poor, and come and follow me, and thou shalt have treasure in heaven." "He that giveth to the poor lendeth to the Lord." "It is easier for a camel to go through the eye of a needle than for a rich man to enter into the kingdom of God." Here the extreme of altruism was proposed, but utterly without discrimination as to the objective effect.

Just as all people assume the moral character of benevolence and charity, so there is a disposition to assume that all altruism is good—in other words, to use it as a synonym. Some writers of much prominence have not properly treated the subject of altruism, and religious writers especially fail to measure its true character—that is, we see forms of altruism held up as the *summum bonum;* its teachings are said to be almost or quite divine. A professor in Johns Hopkins University has recently, in "The Congregationalist" spoken of altruism as the opposite of selfishness, which latter term he also confounds with egoism (and spells it "egotism"). This is very unfortunate. We shall never work out social problems with such confusion of ideas. Seeing men in such positions treat altruism as always a good thing, and seeing them urge its practice without consideration or without limitation, have prompted this attempt to distinguish between justifiable altruism and unjustifiable altruism as carefully as moralists distinguish between justifiable egoism (self-love or self-interest) and unjustifiable egoism (selfishness). And right here the moral philosophers must be alluded to. They have been so zealous to destroy selfishness that they have urged the doing of good to others without sufficiently distinguishing between seeming good and the evil effects thereof. They have too much determined the quality of acts by an examination of the motives under which the acts were performed, and too little by an examination of the effects produced. They ought long since to have studied the character of altruism.

For eighteen hundred years the world has had an altruism which failed to discriminate as to the object, and, as will appear

later, altruism has often been carried to injurious excess, and yet we have had about as good general results as could be expected under the circumstances. The early step from justifiable egoism to that which discriminated was a long one. From the mind resting on self to considering the immediate wants of others was a great advance. From altruism performed with selfish motives to disinterested benevolence was another grand advance. The order of human progress doubtless required a long discipline in indiscriminate altruism before men should learn to differentiate it by observing its results. Again, not only man's mental progress but that of life on the earth has been by pendulum-beats from extreme to extreme, by action and reaction, until finally the golden mean of Horace has been reached. The shield was neither silver, as protested by him who viewed it from the east, nor yet gold, as viewed by him in the west; but, had not each held and proclaimed his opinion, the truth would not have been reached by either. Progress limps and goes by indirections; but the various steps indicated have been taken and well taken.

To Christianity, then, by far the greatest exponent of this indiscriminate altruism, is due the great credit of having taught it, and measurably brought the world from selfishness to disinterested benevolence. It matters not that the race might have traversed this path under some other banner, and that many tribes have found it independently. "Honor to whom honor" permits this willing recognition. Although it overlooked this newer feature, it had enough to do for man of a more primary character.

The most intense manifestation of the altruistic spirit is in non-resistance to evil and in utter disregard of self. How beautiful seem to us those precepts pointing thereto!

"Whosoever shall smite thee on thy right cheek, turn to him the other also. If any man sue thee at the law and take away thy coat, let him have thy cloak also. Lay not up for yourselves treasures upon earth, where moth and rust doth corrupt, and where thieves break through and steal. Take no thought for your life, what ye shall eat or what ye shall drink, nor yet for your body what ye shall put on. Consider the lilies of the field, how they grow; they toil not, neither do they spin, and yet I say unto you that Solomon in all his glory was not arrayed like one of these. Take therefore no thought for the morrow, for the morrow shall take thought for the things of itself. Give to him that asketh thee, and from him that would borrow of thee turn not thou away. Go and sell all that thou hast and give to the poor, and come and follow me, and thou shalt have treasure in heaven."

And yet however grandly its maxims may ring in our ears, whatever praises we may bestow upon its advocates, and whatever satisfaction we may express with the past, the day for this indis-

criminate altruism has gone by, and we are confronted with present duty. To-day, the only man who sells all that he has and gives to the poor is the unfortunate one whom we shut up in the insane asylum. To-day, the only one who takes no thought for the morrow is the tramp or the beggar. (The professional beggar has even sense enough to keep a bank account.) Those extremes of altruism, non-resistance and self-abnegation, have been discarded. And why? —Let us now recognize the virtue in them, and understand also just why they are impracticable.

The virtue of those precepts lies in their power to draw men away from self. Read them slowly—not a selfish motive to be found in them. They remove one the farthest possible from thought of self. At the time when the degradation of women was greatest, when chattel slavery was so universal that even Saint Paul returned a runaway to his master, when political freedom was unknown, when drunkenness and debauchery far exceeded the present, the best thing for mankind was to hold up this extreme of altruism as an ideal and even to declare it divine, which it nearly was in comparison with the evils combated. So long as no one could point out its defects, its force would be and was very great for good. Through the self-inflicted injuries which the early Christians caused in practicing these principles was the tide of human selfishness checked. But the evil of these precepts consisted in their subjective influence being excessive (therefore injurious), and in their utter disregard of ultimate and objective results. He who curbs his own selfish and grasping spirit by taking no thought for the morrow, lays himself liable to want (which is perhaps the lesser of the two subjective evils), but the objective effect is more far-reaching and only evil. It acts as an incentive to others to idleness, improvidence, and ultimate beggary. He who being smitten on one cheek turns the other, cultivates patience and self-control, but he leaves his assailant all the more ready to smite the next man he gets mad with. Again, the subjective effect has good in it; the objective effect has far-reaching evil in it. If I imitate the lilies of the field, which neither toil to make themselves a shelter nor spin themselves clothes, I may be admired for my assurance and freedom from anxiety, but I shall also be cut down by the first frost of adversity, and be ruthlessly swept out of sight by the first snow of winter. Objectively, I shall have set a bad example to weaker minds than mine. They will say, "Let us eat, drink, and be merry, for to-morrow we die." And the world will have paid dearly for my little exhibition of self-culture.

He who, being sued at law for a coat by a grasping neighbor, peaceably folds in a cloak also, may cultivate some useful feelings in his own breast while inflicting an unwise deprivation upon him-

self, but the victorious plaintiff has become a meaner man, and will bring new suits at the earliest opportunity; if not upon this, upon some other man whom he thinks he can browbeat, and there are plenty of lawyers who will help him do so. He who sells all he has and gives to the poor, may, if he is very badly eaten up with greed for money, discipline himself in the right direction, but in selling *all* he deprives himself of the means of self-support in sickness and endangers the care of his family. But all this subjective wrong might be perpetrated to curb a grasping spirit through the loss of property. That, however, which he had no right to do he has done. He has pauperized the poor. The evil inflicted upon scores, and perhaps hundreds, is in their lessening of self-respect, the cultivation of indolence, the enfeebling of their already weak determinations, the putting further away of that day when the poor shall be properly paid for their work, and the fostering of that reckless spirit, "The world owes me a living, and I am going to have it." If the next rich man does not sell out and distribute soon enough, they will thirst for his riches—perhaps for his blood. If some of his wealth is ill-gotten, as is the case with many rich men, they will consider it all so. In such soil the seeds of communism grow. The advocates of anarchy and the haters of government are found always among the poor.

Now note this most remarkable fact—that every single precept pointing to non-resistance and self-abnegation, while subjectively attractive, ignores the objective and ultimate effect; that is, they all seem to be of benefit to the doer, but make not an iota of discrimination as to the effect upon others; while, in fact, as history has shown, and as we are now beginning to know, both are injured; but the greatest harm is done to the supposed beneficiaries.

Self-abnegation is thus as far from virtue as selfishness. The golden mean lies between, where our egoism benefits us but does not sting another, and where our altruism benefits others in its ultimate effects without sapping their or our own welfare. Selfishness is short-sighted gratification of base impulses. Self-abnegation is short-sighted gratification of benevolent impulses. Both are impulsive, both are short-sighted, and both inflict evil upon others.

A more moderate and acceptable form of altruism goes under the names of charity and benevolence. They are also valuable in curbing the spirit of egoism, and have made many people, both givers and recipients, happy for the time being. "To do good and to distribute forget not, for with such offerings the Lord is well pleased." Again, no discrimination is made as to the objects of charity and of benevolence, nor as to the remote and real effects of such action. It seems to have been thus far assumed that no

discrimination need be made. The exhortations to charity and benevolence never specify the objects minutely, while, in fact, this should be the all-important feature. In seeming prohibition to any suggestion of discrimination we are told that benevolence should be universal, because the Creator "maketh his sun to rise upon the evil and upon the good, and sendeth rain upon the just and upon the unjust." Now, in the case of sunshine and rain it would be physically impossible to discriminate. It should also be remembered that the same Creator for the same reason sendeth the lightning and the earthquake to destroy both the just and the unjust. But, what is more to the present purpose, he starves to death those who in summer fail to lay by a supply of food for the winter; he smites with disease those who are too lazy to cultivate cleanliness; and he visits the iniquities of fathers upon *thoughtless* children to the third and fourth generation. Here is a lesson in discrimination of cause and effect not to be overshadowed by a few platitudes about rain.

But we must turn to consider the economic effects of altruism by means of which we are to distinguish justifiable altruism from unjustifiable altruism. So much of description has been necessitated by the newness of the subject, and even now it is to be feared that those who have never discriminated as to doing good to others, except as regards the purity of motive in the doer, will feel more concerned about the integrity of the precepts that have been dissected than about the analysis of truth. Be that as it may—and it would be a matter of regret to offend the ancient prejudices of any—it is to be hoped that the economic remarks to follow will but substantiate and illustrate the principles already laid down.

Now that we have reached the study of social, political, and economic science, we are called upon to analyze the subject, to define our terms carefully, to be sure that we build our sciences on facts, and to state our conclusions clearly. And our conclusions are most hopeful. They are, that in doing real and not seeming good to ourselves we also benefit the race; that in doing good to others it is not necessary or wise that we inflict sore deprivation or indignity upon ourselves; that thrift and wisdom consist in taking a reasonable thought for the morrow; and that in nothing so much should we take anxious thought for the morrow as when appealed to for alms or to assist the needy.

Better that they suffer hunger to-day and be made self-respecting and self-supporting to-morrow, than that they be fed to-day and then be forgotten to-morrow. We best help others by securing them full justice, and by refraining from injuring them either through malice or through giving them that for which they return no equivalent.

I. RELIEF OF THE POOR.—This class does not include the sick, the dependent children, nor the insane, but simply those who are more or less of the time idle, who receive but small wages when they work, and who ask, or do not ask but seem to need, financial assistance.

So many have been willing to lend to the Lord (i. e., give to the poor), believing that it was a safe and dividend-paying investment, that for eighteen hundred years this has been the usual mode of relief.

Everybody knows that this has not diminished the number. It was very unfortunately said, eighteen hundred years ago, "The poor we have always with us," because the saying of it has helped to make it true. Assuming that we are to have the poor always with us, we shall do little to lessen their number. Had it been said upon the same authority, "Under the beneficent sway of wisdom the poor shall cease to exist among you," as it was said, "The wolf and the lamb shall lie down together," by this time we should have been far nearer the realization.

Early Athens—pagan Athens, if you choose—could boast of having no citizen in want, "nor," says the Grecian historian, "did any disgrace the nation by begging." This should have been our motto. With all the resources of this nation, its realization would have been easy had the proper course been pursued. In such a country as ours it is not necessary, but it is a shame and disgrace, to have the poor always with us—that is, poverty which needs relief. In the presence of millionaires, men owning but a single cottage are poor by comparison. We ought always to have such poor among us, but these are self-respecting and happy men. They must never be confounded with those who through defective character sometimes require food, coal, or shelter to be provided for them. The latter are intended when allusion is made to the poor.

Now, if anything of social and economic value has been demonstrated in this century it is that giving food, coal, and money to the poor from public funds or even by private charities pauperizes and degrades them. Henry George says that "the poor are growing poorer." If so, to nothing is it more attributable than to the multiplication of charities. "A city of charities and a city of paupers" is the designation of one of our Eastern municipalities.

How charity becomes the cause of pauperism may easily be understood. The problem has been well worked out, especially in England. Henry Fawcett, Professor of Political Economy in the University of Cambridge, in "Pauperism: its Causes and Remedies," published in 1871, says: "Those get the largest share of charity—not who suffer most, but—who can excite the greatest sympathy. Hence securing charity becomes an art; begging, a

profession. Hypocrisy and lies are the principal tools. Those who acquire skill in it frequently obtain greater incomes than those who labor."

A case in Washington, D. C., illustrates this:* In August, 1885, a boy of about fourteen years was found regularly begging on Pennsylvania Avenue. His mother, healthy and reasonably intelligent, lived in a neat house on a pretty street within three blocks of the Capitol. There was no sign of poverty or of distress about the house, inside or out. The boy had, during the sessions of Congress, sold papers at the Capitol, reaping a rich harvest. He limped about with a crutch. People gave him five, ten, or twenty-five cents for a paper, and asked no change. When Congress adjourned, he could still have supported himself well by selling papers on Pennsylvania Avenue; but people there did not pay over five cents for papers, as a rule. Still, they did give to beggars, especially to those with crutches. It easily appeared that the boy could make more money by begging than by selling papers, and so he begged. Even after he had been taken into police court twice, he returned to the street to beg. It was only with great difficulty that the writer succeeded in stopping this imposition upon the public—the sweet, confiding public, which is ever seeking to give to strangers, because "some have thereby entertained angels unawares"—yes, a public which is too lazy to investigate the effects of its alms-giving, and which deserves to be imposed upon.

Now, let no one express horror at the character disclosed in this child, or rather in his mother, who was the real actor. She was no better and no worse than the average citizen. She simply exercised business sagacity in getting money apart from moral considerations. So do Wall-Street brokers; so do many men who endow colleges, build churches, and send missionaries to "the heathen."

The solution of this economic problem is of the simplest. Make begging unprofitable, and we never need lecture beggars about their loss of self-respect. When the getting of something for nothing becomes impossible, and never till then, will men cease to endeavor to get something for nothing. When you and every one of you completely discontinue giving alms, except to those whose circumstances are perfectly understood, self-respect and other moral qualities will develop in those people without even a word being said to them upon that point. In giving to them, *you* degrade society far more than they degrade it by asking. This kind of altruism is a curse in the world. Fawcett said of it, "England was brought nearer the brink of ruin by the old poor-

* I made the investigation of it in person, and prosecuted it in the police court before Judge W. B. Snell.

law than she ever was by a hostile army." Meanwhile we should be self-respecting enough to admit that tramps and beggars are not very different from many "respectable" people, after all.

Those who are interested to examine the economic results of giving to the poor, in England, Scotland, and Ireland, will find plenty of books on the subject. The "Encyclopædia Britannica" contains a good article under the heading "poor-law." See also other encyclopædias.

The Scotch are proverbially thrifty and economical, and yet they have been degraded by the poor-law of 1845. In some parts of Scotland there is ten times the poverty there is in Ireland! That law gives more relief than England's, and the money is regarded as a nice gift. Those who had savings in banks transferred them to others. Careful investigation, and even the labor test, did not quell the applications in any such manner as did the Irish workhouse. Matters came to such a pass that the fishermen of Wick could not get their nets mended, their former assistants saying that they could get a living easier from the parish.

In Ireland there is very little out-door relief, the proportion of Scotland being almost reversed—five in-door to one out-door pauper. In spite of Ireland's unjust land system and high rents, the whole number of her paupers does not amount to one half those of London alone. The Irish will submit to every privation rather than let friends go to the workhouse, which is the legal mode of relief, and is not a charity.

In London many people get relief who could do without it, and consider it no disgrace. Industry, economy, temperance, and self-restraint would enable most of them to take care of themselves if they would. Hence the workhouse is a necessary restraint, being uncomfortable or even disgraceful. They therefore shun it. If they may eat without work in some other way, they will; if not, many of them will work. Why are these people in such condition? It is a duty we owe to society to ascertain what are their thoughts, what the motives that have led them to such lives. If the result is that the vices and injustices and prodigality of the rich have in part induced such results, let it be exposed boldly and fearlessly. If injustice in the wage system and in land tenure is the cause in part, let this also be proclaimed.

You will, however, be more interested in some figures from our own experience. The Hon. Seth Low, ex-Mayor of Brooklyn N.Y., presented a paper in 1881 at the eighth National Conference of Charities and Corrections in Boston which Robert Treat Paine calls the corner-stone of relief reform. In it Mr. Low sums up his opinion of the world's experience in giving alms (technically called out-door relief). Of the supposed beneficiaries he says:

1. That it saps their habits of industry.

2. That it discourages habits of frugality.
3. That it encourages improvident and wretched marriages.
4. That it produces discontent.

His own conclusion as to what he had himself seen was that "out-door relief in the United States as elsewhere tends inevitably and surely to increase pauperism." Here are some of his statistics:

In Brooklyn, during 1877, 46,350 people were relieved at a cost of $141,207. In 1878 no money was given. This immense number of people which had received aid were left to take care of themselves, or to go to almshouse or to hospital. What effect on these institutions did refusing to give to 46,350 people have? In 1877 and 1878 these institutions contained 1,371 people; in 1879, 1,389 people; in 1880, 1,199, and in 1881 only 1,171. What became of the people that had received the $141,207, in a single year? Mr. Seth Low says: "Instead of Brooklyn needing, as the result of the abolition of out-door relief, an almshouse of mammoth proportions, we find at the end of three years an almost imperceptible increase of sick paupers, but a steady diminution of well paupers; and this, too, in the face of a population in the county growing at the rate of 18,000 per annum." At about the same time similar action was taken in Philadelphia, with like results. Cleveland's out-door relief account for six years was as follows:

1875 to 4,590 families	$95,000.	1878 to 1,568 families	$32,300.
1876 to 3,094 "	85,000.	1879 to 1,550 "	22,600.
1877 to 2,386 "	70,000.	1880 to 1,200 "	17,000.

In March, 1877, was begun a system of requiring an equivalent for the relief furnished. Work at one dollar per day was provided every man who being able-bodied applied for assistance. The officials were thoroughly convinced that pauperism had been fostered and increased by the old system.

Cincinnati pursued the same course, with good results, except that it issued during ten winter weeks coal by the bushel; but even that was improvident and demoralizing. People who know that a city issued coal last winter will count on getting it this winter, and will take no other thought on the subject.

Now we know, by experiment, that the wise thing to do is to visit all such people in July and August, and induce them to lay by a few cents a week for winter's coal, promising it to them at lower prices. If, thus reminded to provide for winter, they are less sensible than the squirrel, they must in all fairness to themselves be allowed to suffer discomfiture in winter and be taught by bitter experience. He who gives to the poor under such circumstances may be very benevolent at heart, but his influence is worse than that of a miser who refrains from giving.

What, then, must we do? Fortunately, our altruistic feelings may be gratified in a manner not harmful to the beneficiaries. Robert Treat Paine, of Boston, who has had large experience in treating the poor, prescribes the following: "Whenever any family has fallen so low as to need relief, send to them at least one friend—a patient, true, sympathizing, firm friend—to do for them all that a friend can do to discover and remove the causes of their dependence, and to help them up into independent self-support and self-respect." To which it may be added, if that friendly visitor is permitted to give alms, his and their minds are diverted from the great object—the permanent cure of poverty. It should always be regretted when circumstances seem to demand attention to immediate needs. Put off every possible want till the person can himself supply it in a manly and independent way. Better a morsel with self-respect than plenty with an enfeebled determination to fight the battle of life.

II. ORPHAN ASYLUMS.—Much that has been said of giving alms applies to the treatment of delinquent and dependent children. Moved by the altruistic spirit, and feeling an approving conscience as the result of trying to do good to others, the Christian world has taken up the care of orphan asylums. Children are gathered from the slums of cities, and sometimes from pretty good homes, in to these herding-places. Then they are told, as I heard from a reverend doctor, how grateful they should be to Christianity for thus caring for them; but the fact again is that, prompted by kind motives, people thus try to do these children good without looking to the results of their acts to see the consequences.

What, then, are some of these consequences?

1. That moral corruption, brought in a little by each child, leavens the whole lump.

2. That they are often placed under incompetent teachers to learn book-lessons, when in fact their capacities call for manual training instead. (Who ever knew a scholar reared in an orphan asylum?)

3. They are fed in the cheapest sort of a way, and clothed in a uniform that causes them to be pointed out always in public as objects of charity and degradation.

4. They are kept in herds and not in families, and hence subject to rules and training necessitated by this abnormal life. Often they are so unfit to live in families that kind-hearted people can not adopt them.

5. Every delinquent mother and every drunken father now knows that he and she can indulge their vices and get rid of their children. Thousands of widowed mothers, learning that they can marry again if not encumbered with children, are putting their little ones in asylums. The asylum thus offers a premium to child-

desertion. Rich people even are living in luxury, while their nephews, nieces, and grandchildren are being corrupted in orphan asylums! The niece of a President of the United States was, not long ago, in an asylum, while her uncle, aunt, and three cousins, occupied the White House! Such people often give as their excuse that the child was too vicious, or rude, or even homely, to be received into their families. "No one seemed to want him."

Better the humble home of a poor farmer in the West, far better for such children as are unavoidably orphaned, than these unnatural corrals. But this kind of orphans constitutes not over one fifth of all. The other four fifths represent indulgence, by the asylum founders and managers, toward parents and relatives who wish to shirk responsibilities imposed by Nature upon them. With every such indulgence issues moral miasma upon society, which festers and reproduces its kind. And all this time people with good motives and benevolent spirits thank God that they are not as other men are, and proceed to build additional asylums! Better and far better live and die among the Zuñi Indians of New Mexico, having never heard of Christian charity, than to die and leave your orphan child alone in a large city of the United States! In the latter case he goes to an asylum, to be swallowed up in the masses. In the former case, although he has lost his own father and mother, he has found many fathers and many mothers, all of whom will feel a personal interest in him and responsibility for him, and who will share with him if need be the last pot of corn, and will weep over his grave as if it contained their own flesh and blood. We should need no orphan asylums if we possessed the virtues of the Zuñi.

How to set forth the economic effects of such institutions, and to point out to society the way to make its members rear the children to whom they have given birth, and to show the disastrous effects of ill-considered altruism, is a task which comes within the province of this section of the American Association for the Advancement of Science.

III. Foundling Asylums.—Here, again, sentimentalism has contributed money to build asylums, and even more unwisely than in the case of the orphans. An orphan can not be committed without something being known of its parents, or their circumstances, and without formal papers of transfer. This routine exposes many frauds, and leads managers to reject thousands of applicants for admission. Managers like to boast of the cases they have rejected. With foundlings, nothing of the sort occurs. The girl whose yieldings to temptation have made her a mother, be she in high life or in low, the intemperate who prefer to use their means for drink to rearing their own offspring, the society people who have boasted that there will be no children in their

families—one and all—have but to leave their offspring as naked as little Moses was when deposited at the Nile, either in a vacant lot or upon some handy door-step. Under cover of darkness all is secret. Either a policeman, or the irate citizen whose door-step has been invaded, quickly and safely transfers the waif to an asylum. The reminders of sin and folly, as well as the burdens of the parents, have thus been put far away. Were society organized to encourage this very business, it were impossible to arrange it more satisfactorily. But eternal shame should rest upon the weak-minded, benevolent people who by their ill-advised altruism cultivate such degradation in society! One tenth of the money spent in detecting and punishing these parents for their unnatural crimes would teach society the needed lesson. More pains than we take to catch a murderer should be spent upon detecting these criminals. Every foundling asylum in America should be instantly disorganized.

IV. Insane Asylums.—Upon this kind of altruistic effort, also a boast of the age, there are not sufficient data to warrant so severe denunciation. It is proper, however, to call attention to some suspicious circumstances:

1. The collecting and imprisoning of great masses of such people is unnatural, and the best authorities advocate breaking up the system by substituting homes and separate buildings.

2. To the non-medical observer it is surprising that, while rapid progress is being made in treating many forms of disease such as are caused by minute germs, so little knowledge is being obtained concerning the nature, causes, and cure of insanity. With many physicians, supported by the state in a liberal manner, why are they not bringing forth fruit in this direction? It is said to be because incapable men get places through intrigues, and because so much time is spent in routine work.

3. The number of the insane is on the increase. Some of the immediate causes are understood. Is it not certainly of the utmost importance that facts bearing on these points be circulated, and that great effort be made to check insanity by rooting out of society the immediate and ultimate causes?

The altruistic work suggested by these questions can have no unjustifiable effects. That which has been performed is more questionable, as implied by the changes proposed, and upon further examination may prove more unjustifiable. In any event it is plain that doing good to those now insane may not be of half the importance that it is to find means of preventing insanity in the future.

V. Benevolence in Higher Education.—It used to be a practice to give not only tuition, but even board and clothes, to young men studying theology. It was considered that they were

preparing to lead lives devoted to altruistic work, and that it was therefore desirable, in the case of young men apparently without means, to pay their expenses in theological schools, but it worked so badly that the plan is undergoing change. In the best schools where funds are provided, they are now loaned, and a written obligation to repay is executed. In other words, the managers of schools of divinity found out that to give to the poor theological student was to lend to the devil—a very different creditor from the one they had in mind! It was found that this money got used at times for tobacco, for pleasure-trips, etc., while board-bills were unpaid, and that after it was spent the beneficiaries sometimes abandoned the life-work they had contemplated.* But even the loan system is not working satisfactorily. The written obligation is often lightly esteemed, and held to be not binding. The writer's latest information is that but thirty per cent is paid back. Only when the notes are looked after, as a successful banker looks after his paper, will the system become truly beneficent. It will then have ceased to be a charity. Again let it be said, *do not give something for nothing*, but, if you really must do so, then put it into a lottery.

VI. GIFTS TO WORKINGMEN.—There is reserved for the last a notice of the most contemptible form of altruism now known to civilization. It has come to be the fashion for people who have acquired money without giving an equivalent in labor and who wish to indulge in benevolence, to build mission-chapels in outskirts of cities, and to furnish them with cheap appliances in order to "save the souls" of the dear working-classes. Another form this takes is in furnishing workingmen libraries and reading-rooms, and even in building improved tenement-houses. In a score of ways the rich are "doing something for the poor." Now, all these things have the same surface appearance of charity as throwing a dime to a beggar. But the fact is, that these people have by class legislation or dishonesty got possession of wealth created by the poor, and in order to quiet their little consciences, or occasionally in order to enable them to keep up the fraud, they dispense these charities.

Now, let it be reported to all such that the workingmen need none of their charities. They cry out for justice, for fair wages for a day's work, for reasonable rents, for a chance to buy house-lots which speculators have not pushed beyond honest men's reach —in short, for such a reorganization of legislation and custom as will enable them to labor and to administer upon the entire fruits of their labor, to build and furnish their own chapels if they

* There has been in government employ in Washington, the past eight years, a young man who received such aid for two years previously. He now owns real estate in Washington, but he never preaches.

choose, to establish their own libraries and reading-rooms, to build their own tenement-houses, and to scorn charity as they now have good reason to scorn such dispensers of charity.

The basing of all so-called charitable and benevolent work upon such principles as have been indicated, or rather the substitution of right-seeking and right-doing (which is but the simple practice of justice), will require earnest study and a great change in our spirit and methods. Those who in preceding years have here listened to outlines of work adapted for this section as presented by Professor Elliott and Major Alvord should notice that the bounds will be much enlarged if we seek to solve the problems which shall enable us to make our altruism economically beneficial. This certainly should be the case. That we should pretend to be doing good to all men, and yet be deceiving both ourselves and them, while really doing harm to both, needs only to be demonstrated to secure our condemnation. And giving alms to show even to ourselves our good motives, or in order to indulge our benevolent impulses, is certainly the most deceitful form of selfishness, since it appears in the form of altruism—is evil and only evil.

THE PROBLEM OF A FLYING-MACHINE.

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IN "The Popular Science Monthly" for November, 1885 (vol. xxviii, p. 1), Mr. Mather closes an excellent article on flying-machines with the following weighty remark: "These are the most important inventions of this class—i. e., self-raising, self-propelling machines. It must be confessed that the results are far from encouraging. *But, there are the birds; and they completely refute the argument of those who say that it is impossible to make a flying-machine.*"

Now, I wish to take issue with Mr. Mather in this conclusion. I am one of those who think that a flying-machine, in the sense indicated above—i. e., self-raising, self-propelling—is impossible, in spite of the testimony of the birds. Of course, it is understood that I am speaking of *true flight*, like that of a bird or an insect, and not of *ballooning* nor any combination of ballooning with flying. This is sufficiently implied in the words "self-raising and self-propelling." I wish now to give, very briefly, a reason for my faith. I can best do so with brevity and clearness by a series of propositions which I hope will lead us, step by step, to absolute demonstration. I believe this is important, in order to check baseless expectations and limit effort to the right direction.

1. Two Kinds of Impossibles.—On the very threshold of my subject I am met by the objection that "many things far more wonderful, and, before their realization, seemingly far more impossible, than flying-machines, have, nevertheless, actually come to pass. Then why not this also? He is a bold man that declares anything impossible in this age of rapid progress and startling inventions." I answer: True enough, many wonderful and apparently impossible things have indeed come to pass; and that, too, in spite of the adverse predictions of some rash scientists. But there are two kinds of impossibles—the *seeming* and the *real*. The *seeming* impossibles we *believe* to be impossible, only because we do not yet understand the principles involved in the problem, and therefore can not conceive the conditions necessary for their successful application. Such are all the cases which most readily occur to the mind as triumphs of science—such, for example, as the locomotive, the telegraph, the telephone, etc. The *real* impossibles, on the contrary, we *know* to be such, because we see clearly through all the principles involved in the problem and the *limits* of their possible application. Of this kind are the *problem of a perpetual-motion machine, and of a self-supporting arch of indefinite length*. Now observe—that, of these two kinds of impossibles, to the unreflecting the *seeming* are far the more impossible and wonderful. In fact, to most people the *real* impossibles do not seem impossible, or wonderful, or even difficult at all. Hence, in every age and country we find men who waste their lives in vain attempts to make perpetual-motion machines. So, also, in regard to the indefinite arch. Most people do not see at once why an arch of any length should not support itself if only it be big and strong in proportion to its length.

Let me stop a moment to illustrate this by an anecdote. I remember many years ago meeting a traveling agent of a Remington bridge (a wooden suspension-bridge), who had with him for exhibition a small model which, when set up, was about twenty feet long, and had stringers about as big as my finger. This little model not only sustained itself, but, in addition, the weight of a stout looker-on—"a fat and greasy citizen"—twenty times as heavy as the bridge itself. "Now," said the plausible agent, "if you increase the size and strength of the stringers in proportion as you increase the length of your bridge, it is evident that a bridge of this pattern, of *any length*, will not only sustain itself, but twenty times its own weight in the form of loaded wagons." Most of those who heard it accepted his reasoning as irrefutable. Of course, every engineer knows that this is not true. For, while the *weight* of the bridge increases as the *cube* of the diameter of all its parts, the *strength* of the stringers increases only as the *square* of their diameter. In increasing the size in

all dimensions, therefore, the weight will quickly overtake the strength. There is a *limit*, therefore, beyond which it is impossible to make an arch or suspension-bridge support itself. This fact is so well recognized that it is unnecessary to dwell upon it. I have brought it forward at all only because I wish to apply the principle to other cases where it is not so well recognized.

2. APPLICATION TO WALKING.—Now, this principle applies not only to bridges and arches, but to all kinds of structures, and therefore, also, to locomotive-machines, whether natural or artificial. For example, there is a limit of size beyond which it is impossible to make a successful walking-machine, and beyond which, therefore, a walking animal can not exist. Beyond that limit the supporting bones would crush beneath the weight of the animal. It is in vain to say that we will make the bones and muscles thick and strong in proportion to the increasing size of the animal; for, as the animal increases in size, its *weight* increases as its volume or as the cube, while the strength of bones and muscles increases only as the cross-section or as the square of the diameter. Therefore, as the animal increases in size, a larger and longer portion of the whole strength is consumed in the support, and less and less is left over for motion, until, finally, the weight overtakes the utmost strength of bones to support or muscles to move. It is probable that the limit of an efficient walking-machine has actually been reached in the largest animals which have walked the earth; such, for example, as the huge dinosaurs of the Jurassic period, recently brought to light by the researches of Marsh and Cope. The whale has probably passed the limit, and therefore was compelled to change its form and take to the water, and become a swimming-machine. Or, to speak more definitely and also more truly, the whale family in times long ago, perhaps in earliest Tertiary times, before it became a true whale family, found it profitable, either for food or for safety, to take to the water; and this not only determined a change of form, but also allowed it to attain a greater size than was compatible with walking.

This principle explains many other things in nature which would otherwise be inexplicable. The marvelous vivacity and energy of insect-motion—the arrowy swiftness of flight of many kinds of flies, the prodigious leaps of fleas, the immense weights dragged by ants—are familiar to all. In text-books on natural history these are given as examples of the almost inconceivable nervous and muscular energy of insects, as compared with vertebrates. It is often said that if *our* nerve- and muscle-energy were as great as that of a flea, we might easily leap a quarter of a mile. In that case we would have little use for railroads or for seven-league boots, or indeed for flying-machines. Now, this is an entire

misconception. There is no reason to believe that *our* muscular energy is any whit less than that of insects—that, taking a bundle of muscular fibers of equal cross-section, the contractile power is any less in *our* case than in theirs. The explanation is easily found in the principle above stated. These apparently wonderful feats of insects are simply the result of their small size. Weight *de*creases as well as *in*creases as the volume, i. e., as the *cube*, while strength of muscle only as the cross-section, i. e., as the *square* of the diameter. Therefore, with decreasing size weight decreases far more rapidly than strength, and therefore the ratio of strength to size *in*creases; and therefore, finally, less and less energy is consumed in support, and more and more is left over for motion. If any one desires to pursue this subject further, he will find it fully treated in a previous number (April, 1883) of "The Popular Science Monthly," in an article by Delbœuf on "Dwarfs and Giants."

3. Application to Natural Flying.—Now, this same principle of limit applies with greatly increased force to flying. There is a limit of size and weight of a flying animal; and on account of the prodigious energy required for aërial locomotion *that limit is very low, not much more than fifty pounds, certainly much less than one hundred pounds.* The largest flying-birds, such as the bustard, the turkey-cock, and the condor, rise with difficulty. They are evidently near the limit. There are, indeed, birds which are much larger, such as the ostrich, the emu, and especially the extinct *Dinornis* and *Epiornis*, but these are all flightless. They do not fly, not because their wings are aborted, but, on the contrary, their wings became aborted because they did not fly, and they did not fly because they had grown too large. Nature could not make them fliers, and therefore did not try. Or rather, it might perhaps be said, she tried her best and failed. Their wings became aborted because their size had passed the limit of possibility of flight. I imagine that the history of their evolution was briefly something as follows: They sprang originally from large birds of heavy flight; but being somewhat isolated from severe competition, on islands with abundant food, natural selection took the direction of *size* and *strength* for victory in contest, rather than *swiftness* of flight for escape from danger. They quickly passed the limit of size for flight, and their wings becoming useless were aborted.

4. Relation of Rising to Propulsion in Flight.—There is another principle involved in flight which must now be stated. There are two things to be considered, viz., *rising* and *propulsion.* We have already shown that the ratio of weight to strength, and therefore the *difficulty of rising, in*creases as the size or weight. We now add that the resistance of the air to motion through it,

and therefore the *difficulty of propulsion* of a flying animal, decreases in the same ratio. The one varies *directly*, the other *inversely*, as the size.

This is a principle of very wide application, and I stop to illustrate it by many familiar phenomena. The floating of dust and smoke, the suspension of clouds, the slow settling of fine sediments, are examples. As the particles become smaller, the resistance of the air or water to falling through it, decreasing as the surface, i. e., as the square of the diameter of the particle (d^2), while the force of motion or weight decreases as the volume, i. e., as the cube (d^3) of the diameter—evidently the force decreases much faster than the resistance, and therefore the ratio of force to resistance, or the *effective force* of motion, becomes less and less, until in very small particles it is a vanishing quantity. For this reason it matters not how great the specific gravity of a substance may be, if the particles are only small enough they will float indefinitely in air or in water. Particles of gold may be made so small by precipitation from solution that they will require months to settle. Krakatoa-dust (if that be the true cause of the after-glow and of Bishop's ring) remained suspended in the air for more than two years. The perennial blue of the sky and of mountain-lake water is due to suspended particles.

Now, this principle applies not only to resistance of the air to the *force of gravity* in *falling bodies*, but also to resistance of the air to the *force of propulsion* in *flying bodies*. As a flying animal becomes smaller (as in the smaller birds and in insects), a larger and larger proportion of the whole flight-energy is consumed in *propulsion*, and a less and less proportion is necessary for *rising*. On the other hand, as a bird becomes larger, a progressively larger portion of the whole flight-energy is necessary for *rising*, and less and less is necessary for propulsion, until finally at the limit the whole is necessary for rising. Beyond this, of course, flight is impossible. This explains why large birds like the condor rise with difficulty; but once up they sail with ease and grace,* while small birds and insects rise with ease, but require rapid and incessant fluttering in progressing.

5. APPLICATION TO A FLYING-MACHINE.—Many readers who have followed me thus far with entire assent will probably object right here that, while all this may be true of *flying animals*, it may not be true at least to the same extent—i. e., the limit may

* Marey has lately ("Nature," vol. xxxvii, p. 369, 1888) shown that there is still another reason for the greater ease of flight after the bird is well on its way. In starting, the wing, except at the very beginning of the stroke, pushes against air which is already in motion in the same direction as the wing itself; but in swift flight *the whole stroke is against dead air*, for the air beneath the wing is continually renewed by the motion of the bird.

not be so low—in *flying-machines*. There are forces, they will say, such as steam, electricity, explosions, etc., which are far more powerful than muscular contraction. Especially is electricity looked to in a vague way to do for us many wonderful things, this of flying among the number. Now, this is again a great mistake. Nerve-energy acting through muscular contraction, and supplied by the combustion of foods, such as oils, fats, starch, sugar and fibrin, together form the most perfect and efficient engine that we know anything of; i. e., *will do more work with the same weight of machinery and fuel.*

There was much loose talk a few years ago about condensing and storing electricity in immense quantity, in small space, by the use of Faure's battery. Millions of foot-pounds, it was said, may be thus condensed and stored in a small box and carried about. To the unreflecting, millions of foot-pounds seems a very large quantity. Extravagant expectations were thus raised in the popular mind. I remember at that time talking with a very intelligent gentleman on this very subject of flying-machines; and he, in rebuttal of my argument, suggested the use of stored electricity. "Why," said I, "there is more energy stored in a piece of coal that may be put in the vest-pocket than can be stored in a Faure's battery weighing three hundred pounds!" Faure's battery is doubtless a good thing, but chiefly, like a fly-wheel, not for increasing the *amount* but regulating the *flow* of force. He then suggested the enormous force of explosives, such as the nitro-compounds. The feeding of these to the engine might, he rightly thought, be so regulated as to supply a continuous force. But here also lurks a fallacy, the result again of a misconception. The force of such compounds is characterized by great *intensity* rather than great *quantity*. The whole force is compressed into an almost infinitely small space of time, and therefore very intense. But stretch it out as a continuous force and it becomes no greater, probably less, than that of an equal weight of burning coal. There is probably no greater available energy in the world than that produced by the burning of carbon and hydrogen. It is this form of energy that we use in steam-engines; this we find most powerful and economical in making electricity; this, also, is what is used in the animal machine. The only question that remains, then, is the *relative economy of its use*. Now, I think it will be admitted on all hands that no known engine compares in this respect with the animal body. It is acknowledged by mechanical engineers that the animal machine, burning hydrocarbonaceous food, and acting through nerve and muscle, more nearly approaches the theoretical limit of possible work than any, even the best, steam-engines. More accurately, the animal body is about twice as effective as the best Cornish engine.

The reason of this wonderful effectiveness of the animal machine is obvious. See how this machine has been gradually perfected throughout infinite ages, especially in birds. During the whole geological history of the earth this machine has been steadily improving in structure of skeleton, energy of muscle, and rapidity of combustion of fuel, by struggle for life and survival of only the swiftest, the most energetic, and the hottest-blooded, until an almost incredible intensity is reached in birds. Moreover, in them everything is sacrificed to the supreme necessity of flight. Viscera, skeleton, legs, head, all are made as small and light as possible to make room for the great pectoral muscles working the wings. Add to this the exquisite structure of the wings and feathers, adapting them for the greatest effectiveness; and we must admit that a bird is an incomparable model of a flying-machine. No machine that we may hope to devise, for the same weight of *machine, fuel,* and *directing brain,* is half so effective. And yet, this machine thus perfected through infinite ages by a ruthless process of natural selection, reaches its limit of weight at about fifty pounds! I said, "weight of machine, fuel, and *directing brain.*" Here is another prodigious advantage of the natural over the artificial machine. The flying animal is its own engineer, the flying-machine must *carry* its engineer. The directing engineer in the former (the brain) is perhaps an ounce, in the latter it is *one hundred and fifty pounds.* The limit of the flying animal is fifty pounds. The smallest possible weight of a flying-machine, with its necessary fuel and engineer, even without freight or passengers, could not be less than three or four hundred pounds.

Now, to complete the argument, put these three indisputable facts together: 1. There is a low limit of weight, certainly not much beyond fifty pounds, beyond which it is impossible for an animal to fly. Nature has reached this limit, and with her utmost effort has failed to pass it. 2. The animal machine is far more effective than any we may hope to make; therefore the limit of the weight of a successful flying-machine can not be more than fifty pounds. 3. The weight of any machine constructed for flying, including fuel and engineer, can not be less than three or four hundred pounds. Is it not demonstrated that *a true flying-machine, self-raising, self-sustaining, self-propelling, is physically impossible?*

6. APPLICATION TO A SWIMMING-MACHINE.—But is there not a way of escape from the toils of this inexorable logic? We have said the limit of the weight of a flying animal is about fifty pounds. The limit for a walking animal is much higher, probably several tons. For a swimming animal there is *no limit of weight and size,* because the water sustains the weight, and therefore the

whole energy may be used in propulsion alone. Now some may think they see in this a solution of the problem. They will say, "Why not sustain the machine by gas, so that the whole energy may be expended in propulsion alone?" I answer, that in proportion as the balloon principle is added to the flying principle, in the same proportion is *size increased without corresponding increase in power;* and therefore in the same proportion is increased the resistance of the air to propulsion, and, what is worse, in the same proportion is our machine at the mercy of winds. But it will be objected: "See the fishes, how they swim! *They* are not at the mercy of currents. They float suspended in the water—they dart forward against currents—they ascend cascades and leap waterfalls; in a word, they are largely independent of water-currents. Now suppose we make a machine exactly the shape of a fish, tail and all; then, by the addition of gas, make it the same specific gravity as the air; then, by machinery, make it wiggle its tail in the manner of a fish. Where is the difference? Why may we not make an aërial swimming-machine, if not a true flying-machine?" Doubtless it is in this direction that we must seek the partial solution of the problem, not indeed of flying, but of *aërial navigation.* Yet the answer to the extravagant expectations expressed above is plain. The fish—its bones, muscles, viscera, brain—the materials out of which are made machine, fuel, and engineer, are of the same specific gravity as the medium (water) in which it swims. Now, whenever we can find materials out of which to make our machine, fuel, and engineer, which shall have the same specific gravity as the air, then, indeed, we may make a successful swimming-machine which shall be independent of winds. But so long as our materials are six or seven hundred times (wood), or five or six thousand times (iron), as heavy as air, we shall not succeed, because of the enormous dead space filled with gas that we are compelled to use, which adds to the resistance of the air and the power of the winds, without adding anything to the power of propulsion.

Therefore, we repeat, a pure flying-machine is impossible. All that we can expect—all that true scientists do expect—is, by skillful combination of the balloon principle with the true flying principle, to make *aërial navigation* possible in moderately favorable weather—in other words, to make a *locomotive balloon*; or, if we choose so to call it, an *aërial swimming-machine.* That something really useful of this kind will eventually be made, there can be no reasonable doubt.

SUN-POWER AND GROWTH.

By JULIUS STINDE.

WE know that our planet retains the position which it occupies in the solar system through the force of gravitation; we know, furthermore, that all organic life on our earth depends upon the warmth and the light which it receives from the sun; but of the intimate relation which exists between organic life and the changes taking place on the sun we are in comparative ignorance, notwithstanding investigation has brought to light a number of important facts.

That the growth of plants in our zone stands in intimate relation to a rise in the temperature of the earth is well known; but the fact that a force varying in intensity and influencing the growth of the human organism proceeds from the sun is a discovery as novel as it is interesting. Some phenomena, possibly referable to a property of this kind, were observed during an experimental investigation of the diet furnished to the inmates of the Royal Deaf-Mute Asylum at Copenhagen.

When, some years ago, a change of diet was proposed for the inmates of this institution, the director, the Rev. R. Malling-Hansen, thought it desirable to obtain a clear idea of and some definite data concerning the thriving of the children under the system then practiced, by which the results and the value of the new system of nourishment proposed could later on be accurately determined. The conscientiousness of the superintendent and pastor of the asylum would not permit the permanent substitution of a new system of diet without first possessing some facts by which its advantages or disadvantages would be plainly pointed out.

For this purpose the children were daily weighed and measured in groups, in which manner the total weight of the pupils was quickly and accurately ascertained. The technical details as well as full statistics on the subject will be found in Rev. Malling-Hansen's work, "Periodicity in the Weight of Children and in the Heat of the Sun" (Copenhagen, V. Trydes). These weighings present some very interesting facts.

Until then it had been supposed that the growth of a number of children (of different ages) averaged the same throughout the year, and that the increase in weight as well as in height of a greater number of children might be registered by a straight line slanting upward. The annotations of the weighings and measurements of the Royal Deaf-Mute Asylum at Copenhagen proved, however, that the universally accepted biological theorem is wrong, for the weight-lines of about seventy children had no even gradation but showed great changes during the year. During

each of the three years the greatest increase in weight took place in the fall until the beginning of winter, then till the end of April the increase grew less, and after this time a loss in weight was noticed. At times the increase in weight of the children would cease suddenly for a few days, and occasionally during the time when an increase was expected a general decrease occurred. Based upon his measurements and annotations, Malling-Hansen framed the following rule: The weight of a boy ranging from the age of nine to fifteen undergoes three periods annually—a maximum, a medium, and a minimum period. The maximum period lasts four and a half months, commencing in August and ending the middle of December; the medium stage has the same duration, from the middle of December to the end of April. The minimum period appears during the remaining three months, from the end of April to the end of July. The increase in weight during the maximum period is three times that of the medium period, and almost all the gain of the medium period is again lost during the minimum period. From the working of this law it follows that in changing the diet at academies, schools, and asylums, the season should be considered. A good diet would give less satisfactory results if observed from April to June, than a poorer diet if noted from August until December.

In the same manner as the *increase* in *weight*, the *increase* of *growth* fluctuates, and can likewise be divided into three periods. These periods commence and close about a fortnight before the periods of weight, but in such a manner that the minimum period of growth occurs at the time when the weight remains stationary, and may at times even be coincident with important loss in weight. Growth takes place, one might say, at the expense of the increase of weight. Accurate observation showed that the general growth of the trees in the garden of the institution corresponded essentially with the growth of the children. The maximum period of growth upward is followed by that of increase in circumference. The growth of the human body and the growth of the trees are consequently influenced in the same manner by some disposing cause. But what is this cause?

As the fluctuations referred to above coincided strikingly with the fluctuations of atmospheric warmth, Malling-Hansen believed that they could be attributed to local meteorological conditions; and it was really shown that with a rise of temperature the weight increased, and *vice versa*. It was, however, ascertained that during the minimum period a rapid rise of temperature but slightly affected the increase in weight, and in the same way the decrease in temperature during the maximum period influenced the weight but little.

Furthermore, it seemed remarkable that the children should

lose in weight instead of gaining, with the progressive rise in temperature in spring and in early summer, and that in fall the opposite relation should obtain. If heat alone were the active medium, the warmth indoors in winter would exert some influence; this was, however, not the case. Many other observations indicated that local changes of temperature were not the looked-for cause, as the fluctuations in weight of the inmates of the Royal Asylum corresponded to those of the deaf-mute children, notwithstanding the great difference in the location and surroundings of these two institutions. The force, moreover, seemed not to be influenced by the seasons, but to continue invariable during frost and heat, during sunshine and rain; its action on the whole was not affected by the warmth of indoors or by the cold without.

The fluctuations of the increase in weight were more regular than those of temperature; these fluctuations, with their great variations and their periodicity, seemed to show that organic growth, of both human beings and animals, is affected by some to us as yet unknown cause. This influence is partly mirrored in the local fluctuations of temperature, and these again, of course, are in connection with the sun.

If the inference should prove correct that increase and decrease in weight vary with the solar radiation, the thermometric registration of places on the Continent, not exposed to sea-winds, would coincide more accurately with the results of the weighings than the local climatic condition of Copenhagen would render possible.

Mr Malling-Hansen undertook the task of tracing in curves the fluctuations in temperature of different meteorological stations recorded in the Danish Institute of Meteorology. The stations, which are at the following places, permit a broad view, as they are at great distances from one another: Copenhagen, Vienna, San Fernando, Lucknow, Tragpoor (India), Paramaribo (Guiana), Cordova (Argentine Republic), Port Dover (Canada), and Vioi (on the Congo).

The more these curves were compared with one another, the more did they show a remarkable analogy between the fluctuations of temperature over the whole globe, and the fluctuations in the weight of the children at Copenhagen. And, furthermore, the curious fact was discovered that the fluctuations in temperature in India, as well as in Copenhagen and in North and South America, varied in a similar manner, and were analogous to the fluctuations shown in the weight-increase of the children in accordance with the variations of temperature experienced at the different places. All these fluctuations in the weight of the children picture the result of an influence emanating from the sun.

All the growth on the globe, from the most minute to the largest being, from the simplest to the most perfect organism,

with all its variations and fluctuations, stands in close relation to the sum-total of heat of the earth's atmosphere.

As, however, the warmth of the sun is influenced differently at different places by clouds, by wind, and by dampness, it never reaches the organisms in its original condition. Notwithstanding this, however, the fluctuations of weight-increase progress in harmony.

Whatever it is that thus influences growth comes to us with the speed of the sun's rays; it varies from day to day, its intensity is the same at the same time throughout the globe, and it is not subject to local causes, to changes by wind and by weather.

Malling-Hansen calls this force "energy of growth"; he supposes that it reaches the earth with the speed of the heat-rays; separates from these, undergoes manifold changes, and, spreading over the whole earth, is the cause of the uniform fluctuations in the growth of all organic life. Upon future investigations falls the burden of proof of this assumption.

This influence of the sun-power may serve as an important factor in testing systems of nourishment, in the arrangement of diet-cures, and in studying the action of mineral waters. For instance, what weight can be attached to an opinion formed on the medicinal value of a mineral spring, if the test be made at a time when the energy of growth is on the decrease, and is thus perhaps assisting in the action of the spring, which at some other period might prove itself only half as efficient?

Good nourishment, a limited amount of mental effort, and as far as possible healthful surroundings during the maximum period of growth of girth, may tend to re-establish the right proportion of stature in children who have grown too rapidly.

There is no known reason to doubt that adults gain and lose in the same periods. If persons who are desirous of growing less stout leave the watering-places at the end of August or earlier, they do so at the time of weight-increase, and a careless diet will hence, in shorter time than it would under similar circumstances in winter, cause them to grow stouter again.

With regard to the school vacations, these should be given from the end of June to the beginning of September, during the two maximum periods of growth; the bodily strength which has been gained will aid the mental work.—*Translated for the Popular Science Monthly from Daheim.*

Prof. Gairdner has called attention, in the British Medical Association, to the need of medical students receiving more adequate instruction in physics. The subordination of living bodies and physiological processes to all the most elementary laws of matter; the correlation of all the physical forces; and the medical methods involving applications of pure physics, combine to make this matter an extremely important one. The physical laboratory will probably in a very few years become an essential aid in the education of the physician.

AINU FAMILY-LIFE AND RELIGION.

By J. K. GOODRICH.

UP to the age of three or four years an Ainu child is called *ai-ai* (baby), without regard to sex. From that age until about seven, a boy is called *sontak* and a girl *opere*. From seven until about sixteen or eighteen a lad is called *heikachi*, and a maid *matkachi*. After that age a maid is called *shiwentep*, or woman. From eighteen to thirty a young man is called *okkaibo* or *okkaiyo*; after the age of thirty a man is an *Ainu*—that is, "a man."

The boy is trained in fishing and hunting by his father and the other men of the village, and at the age of about twelve accompanies the men in their manly vocations. The girl assists her mother and the older females of the family in gardening and cooking; in cleaning, salting, and curing fish; in spinning, weaving cloth, and making clothes; and generally in all the drudgery of the household, for the Ainu man is as lofty in his notions that labor is beneath his dignity as is the North American Indian.

While not as demonstrative in their affection for their children, I think the Ainu parents love their little ones quite as tenderly as any other people; and if Miss Bird's observation is correct, they have one pleasant way of displaying their affection which one does not see through the length and breadth of the empire of Japan, and that is the kiss of affection.

There is no ceremony of any kind, nor isolation of the mother, before the birth of a child. As the women are not allowed to offer prayers or take any active part in religious observances, the prospective mother can not ask the gods for their assistance at the time of delivery in order to make parturition easy; indeed, it would probably never enter the head of an Ainu woman to thus interfere with the course of Nature. The father, always preferring sons, and being extremely anxious for a male heir, if he has none already, will pray to the gods to give him a son, and offer libations of *saké* to the goddess of fire, if his means admit of the expense, or his desire is sufficiently keen to justify the extravagance.

Parturition is very easy, due to the active habits of the women, and is greatly assisted by their physical conformation, as they have broad hips and great strength in the pelvic region. The woman continues her daily tasks until the labor-pains actually come on. She then retires to her hut, where she is attended by a few of her most intimate relations, and, if it be her first baby, her mother will doubtless officiate as midwife. As the kneeling position which a woman assumes at the time of delivery greatly facili-

tates the passage of the child through the pelvis, and tends to expedite the after-birth, the woman in a surprisingly short time resumes her household duties quite as if nothing unusual had occurred. There is no ceremony of purification for the mother, nor does she receive congratulations. On the contrary, it is the

FIG. 1.—AINU OF YEZO.*

father who is congratulated; and when the poor mother has taken up her drudgery once more, it is *he* who remains by the fireside, wrapped up in his good clothes, to receive the felicitations of his relatives and friends, smoking constantly and drinking many a

* For the illustrations in this article we are indebted to "Unbeaten Tracks in Japan," by Isabella L. Bird.—EDITOR.

cup of *saké*, particularly if the baby be a boy and the heir. I was greatly surprised to find this near approach to the *couvade* in this part of the world, and this one little thing seems to separate the Ainu further than ever from the Japanese.

The children are trained to render strictest obedience to both parents; and if there be several sons, the eldest, as heir, exacts and receives implicit obedience from his younger brothers; from his sisters obedience comes without saying, so low is the social position of women. Adoption obtains to quite the same extent as among the Japanese, and the legal standing of the adopted child seems to be as absolute as if his right were that of birth. Adoption is, however, almost restricted to male children, though I was much surprised to find that one childless couple had adopted a little Japanese girl who was so young that she had never learned to speak the language of her own people.

If a man have only female children he will sometimes adopt an heir, but this is not altogether necessary, since the husband of the eldest girl will usually succeed his father-in-law; and, in order to thoroughly fit himself for his prospective heirship, he moves into his wife's home and becomes a member of her family. But if a couple be childless they will surely adopt a son, for, inasmuch as inheritance is strictly in the male line, there must be some one to take possession of the house and the personal property, and to become the head of the household, Not that it is necessary to continue the family name, for there is nothing of the kind among the Ainu. Each person has but one name, without any prefix or suffix to determine whose child he may be, and the name is often given from a mere whim; as, for example, if a baby-girl pitches upon a dirty old pot as her favorite plaything (and this is a very possible case, for toys are not common), the chances are that she will very soon be designated as "The Pot" or "The Kettle" by the family, and eventually the name will become affixed to her. Hence we may say that names are given to Ainu children very much the same way that nicknames attach themselves to children in America and Europe.

Not only are there no family names, but each person's name dies with its owner; the repetition of a name in different generations having nothing to do with the preservation of the memory of an older person. Children are not named for a rich uncle or a maiden aunt, to secure "prospects" for them. There are no posthumous names as with the Japanese, and a dead person is not spoken of by name if it can be avoided by any circumlocution; indeed, every effort is made to avoid all reference to the dead.

The adoption of an heir is not often necessary, for barren wives are sometimes sent back to their fathers; this misfortune consti-

tuting one of the best reasons for absolute divorce among the Ainu, as among savage and barbarous nations the world over.

Children are sometimes betrothed by their fathers when quite young, and this is done without the intervention of a middle-man. This is not usually a matter of commerce, but often occurs when two men, during a drinking-bout, conceive a great friendship for each other. It frequently happens, however, that two rich men, desirous of combining the wealth of their respective families, will betroth their children. But betrothal is not absolutely binding upon the young people, for the veto power remains with the children; and if, upon reaching marriageable age, either of the principal parties to the marriage feels any inclination to do so, he or she will annul the betrothal contract, in which event any presents that may have been given must be returned, or their value fully recompensed to the donors. It is sometimes a difficult matter for the girl to have her own way, for there are conventionalities even in Ainu society; but the boy simply takes the law into his own hands and consummates wedlock with the object of his affection, and, when her condition betrays the fact, opposition often ceases!

At the time of betrothal, if the choice be an independent one on the part of either the groom or bride, it is customary for the fathers to exchange presents, of no great value, to be sure, but sufficient to show their approval of the match. Long engagements are not popular, and when once a betrothal has been effected the pair are soon married, if they are of suitable age—that is, about eighteen or twenty for the man, and sixteen or eighteen for the woman. It will be noticed that there is a certain doubt expressed in all matters pertaining to age, time, etc. This is because the people have no record of time, except to mark the recurring seasons, and do not themselves know how old they are.

When two young people are married, the wedding-feast is usually held at the house of the groom's father. The village chief (or his representative if he can not attend in person) and all the members of the two families attend, with the immediate relatives and the nearest neighbors. Like all their social and religious meetings, the occasion is made an excuse for *saké*-drinking—the men drinking themselves into a state of intoxication. As they are hard-headed fellows, and take their liquor cold (instead of heated, as the Japanese do), the quantity of *saké* consumed is sometimes enormous. To give some idea of the Ainu excessive fondness for *saké*, I may mention the fact that many of the northern Ainu often refuse to work for money-wages, and stipulate that they shall receive *saké* in full payment before they will commence.

The mistress of the house superintends the preparation of the wedding-feast, and is assisted by all the assembled women in pounding the millet and making wedding-cakes, which are boiled,

like dumplings. The groom is expected to provide most of the *saké*, if not all of it, as he is supposed to have engaged in manly vocations, to have received his share of the products of hunting and fishing, and to have accumulated enough money to buy the ceremonial wine, or beer rather, as *saké* is a brewed beverage, not a fermented or distilled liquor.

The newly married couple at once take possession of a new, small hut, which has been erected for them. These huts are made with a light frame of poles, the sides and roof being heavily thatched with reeds. They are by no means warm or impervious to the weather; indeed, many breaks in the thatching admit of ventilation to a degree that must lower the temperature in winter to a point well-nigh unbearable. The first hut is usually built upon ground belonging to the bride's father, and near his own house; but the location of the new hut seems to depend in a measure upon the manner of asking in marriage. If the groom or his father asks for the bride, then, to compensate the bride's father for the loss of his daughter, the groom goes to live on his father-in-law's land and becomes a member of his household; but if, on the contrary, the application has come from the other side, and the bride (as may sometimes be the case) or her father has asked for the groom in marriage, then compensation is considered to be due to *his* family, and the bride goes to her husband's land, becomes a member of her father-in-law's family, and assists in the domestic duties of her new home. An exception to this rule may occur when the bride's father has no sons, and asks for a husband for his oldest daughter in order to secure an heir.

When first married an Ainu couple is considered well set up in housekeeping if a small hut is provided with barely sufficient room for them to sleep on the left-hand or northern side of the central fireplace, a tiny little platform at the eastern end, opposite the entrance and under the sacred window, and a space on the right of the fireplace for guests, of about the same dimensions as the sleeping-place. For furniture there will probably be some mats to sit and sleep on, some rugs or skins for covering, a kettle, and a few dishes in which to serve food. As the family increases—and this is almost sure to be the case, for a childless family is unknown unless the fault is the man's—the house is either added to, or (as is more frequently the case) taken down and entirely rebuilt in more and more pretentious proportions, until it has its entrance porch opening to the south, its anteroom in a western extension, and its main apartment, sometimes thirty or forty feet square. Near it will be a small storehouse raised on stilts, and at one side a little patch of garden for beans, millet, etc.

When the newly married couple take possession, a housewarming is held. This, like every Ainu ceremony, is merely an

excuse for *saké*-drinking, and, instead of bringing assistance to the young people in their early struggles, rather tends to deplete the none-too-plethoric purse; for the beverage is provided by the groom, whose resources will have been severely taxed when he has furnished *saké* for the marriage-feast and the house-warming as well. At the latter feast a prayer is offered to the goddess of fire, by the village chief or one of the elders, invoking her protection for the house and its inmates, and asking that male children may be numerous and strong. This is called *chisei nomi.*

Marriages are seldom contracted between residents of different villages, and if the Ainu kept anything like a record of blood-relationship, marriage between first cousins would probably be found the rule rather than the exception. But that inhabitants of different villages do intermarry is proved by the fact that they have words in their language to indicate the fact. Thus, *iriwak* means blood-relations, those who are received into the family circle and are close together (a village is virtually a large family), while *iritak* means distant relations, those who are taken away. Again, the names of those who go from their own village to wed with those of a distant village are changed, but whether or not this is done according to any rule is not quite clear; certainly there is nothing in the new name to indicate the birthplace of the person. With increasing facilities for traveling and temptations to wander in search of employment, these marriages out of the family circle are becoming more frequent.

Polygamy is permitted indefinitely, the number of wives being determined by the wishes of the man himself and his ability to secure a plurality—one can hardly say his ability to support them, since the support of the man himself and of his family is mainly provided by the women.

Widows are isolated for a period of three years, during which time each lives in her own little hut, supporting herself as best she can by doing a little gardening and by catching a few fish at night in a semi-surreptitious way. They must wear a distinctive cap during this period, and are not allowed to participate in any of the ceremonies of the village. At the expiration of the three years they doff their caps, resume their places in society, and are once more "eligible," and, if known to be good wives and mothers, are sought after. Old women (widows) with grown-up children are exempted from this enforced seclusion, and are supported by their offspring.

Adultery is strongly opposed by the Ainu, and is severely punished; the guilty parties (unless they are young people who can atone for their crime by marriage) being sometimes strung up by the heels until nearly dead. "The other crimes, recognized by

general consent, were theft, incest, murder, suicide, infanticide, disobedience to parents, and idolatry, as well as exposure of person. In ancient times every village was governed by three chiefs subservient to Sara. These chiefs never had absolute authority; all crimes were submitted to the judgment of as many members of the community as cared to be present" (Batchelor).

Inasmuch as there are no family names, no village, tribal, or national rights to be respected, there is nothing approximating to father-right or mother-right. Or perhaps it would be more exact to say that, inasmuch as women are only recognized as servants throughout their whole lives, and as mothers as soon as they have reached the proper age, the personality of the whole family is sunk in that of the husband and father while he lives. When he dies he is at once and absolutely forgotten (except so far as is mentioned hereafter), and each surviving member of his family pursues an entirely separate course, in no way concerning himself about the others. If a man dies and leaves a family of infant children, the care of them devolves upon the mother until the oldest son reaches the age of about eighteen; then he becomes the head of the family. Female inheritance is utterly unknown, as would be expected in a society wherein women have no rights at all. If a man is so unfortunate as to leave no true heir, or so careless as not to have adopted one, his property goes to his next younger brother, or his nearest male relative, if he have no brothers either by birth or adoption.

When very sick, an Ainu *man* (the women may not pray at all) will call upon the fire-goddess, who is reckoned a great purifier, thus: "*Abe kamui, yekoingara wa en-kore*" ("O fire-goddess, condescend to look upon me"). Upon the approach of death, the master will lie close to the fire on his own side of the hearth, partly for the sake of the warmth, but probably in a measure for any possible benefit to be gained from propinquity to the realm of the fire-goddess. Then the village chief and elders, and the sick man's friends, all come to see him; the men to pray and "drink to the gods," while the women weep and wail in rather a noisy fashion, since they are denied the comforts of religion! There are times when the patience of the praying men becomes exhausted, if no favorable answer is given to their petitions. Mr. Batchelor tells of one death-scene which he witnessed when two men were praying to the goddess of fire and another toward the sun-rising through the eastern window; while a fourth was looking toward the northeast corner of the hut (which corresponds in a measure to the *latrine* of Japanese houses) and swearing most vehemently at *all* the gods, something after this fashion: "You fools! why don't you pay some attention to us? Can't you see that this man is in great danger? Here we've been praying and praying for

him, and yet he doesn't get well. What's the matter? Are you deaf? Can't you hear us?"

When death actually takes place, and the friends are convinced by the coldness of the body that there is absolutely no hope of recovery, preparations for burial are immediately begun. The corpse is not washed or anointed in any way, embalming being quite unknown to this people: it is dressed in its newest clothes; the outer garment, which reaches nearly to the feet, is folded over the body and neatly laced up in front like a boot, and further secured by the girdle. The feet and ankles are carefully wrapped, when possible, in white rags, and the hands and arms are similarly covered. The man's bow and quiver and his gun are laid by his side, and his pipe and tobacco-pouch are stuck in his belt. With the possible exception of the smoking implements, these articles are not interred with the corpse, but are simply placed as insignia of its manhood during the funeral feast which immediately takes place. For this feast, cakes made of millet-flour, and boiled somewhat in the same manner as dumplings, are prepared by the widow and female relatives of the deceased. They are similar to those used at the wedding-feast. The cakes are eaten by the men who assemble for the occasion, by whom a great deal of *saké* is drunk. A small libation is offered to the man's memory and to the gods. In doing this the men dip one end of carved flat sticks, which they use as mustache-lifters, into the *saké* and sprinkle a few drops toward the corpse, the fireplace, the east window, the northeast corner of the house, and round in front of them generally. The act of drinking the *saké* is in itself a religious one, as they say that in "drinking to the gods" they show their reverence; therefore the more they drink the better, and an occasion when all become intoxicated to absolute stupefaction is by some thought to give pleasure to the gods and to be blessed by them. As the village chief is its priest and performs all religious ceremonies, his presence at the death-feast is essential. He conducts the ritual—if the orgies may be dignified by that term—the men all participating, and the women acting as servants. If for any reason the chief himself is unable to be present, he sends a substitute.

When the cakes are eaten and the *saké* all drunk (and the men sufficiently recovered from its effects to be able to move), the body is slung upon a pole, borne to the grave by the nearest male relatives, and immediately buried. No particular time is chosen, nor is any attention paid to the situation of the grave. This seems very strange when it is remembered that the east is considered the sacred direction, and one would naturally suppose that some care would be taken to place the corpse in an east and west line, perhaps with the head slightly raised and looking

toward the rising sun. But such is not the case: a shallow grave is dug, the body—rolled in a good mat—is tumbled in, a few stones perhaps thrown in to prevent animals from disturbing the remains, the dirt hastily replaced, and the corpse is left to its fate. Sometimes the pipe and tobacco-pouch, or a small package of tobacco, will be buried with the man, if he has been specially fond of smoking. This fact, and the additional one that a stout stick or club is provided to furnish the man with means of defense, point to a belief in a transition state, but the Ainu has only a hazy idea of the hereafter, and particularly as to purgatory, or the passage of the soul, which is thought to be naturally immortal, to the reward or punishment it is to receive in *Pokna moshiri*. "The wicked are supposed to be harassed by the evil spirits—*nitne kamui*—in this place, but what the rewards of the righteous are the Ainu have no idea."

It is customary to put up a short stick at the head of a grave, the carved top of which indicates the sex of the person therein buried. If it is a man, the top of the stick will be cut in the shape of a spear-head; if a woman, it will be a rudely shaped ball. There is nothing to correspond to a tombstone either at the grave or in the village, where there is no temple, as in every Japanese village, with memorial tablets and altars to keep alive the memory of the deceased. Indeed, it appears to be the desire of the Ainu to forget the dead as soon as possible; their reluctance to speak of them is an evidence of this. In the case of women this is absolutely so, a possible exception is mentioned below. In the case of a man, his son may offer a small libation of *saké* at his grave, and at the *inao* raised to his memory at his former home, on the anniversary of his death; and, in the case of a prominent chief, the men will perhaps do this for two or three years—never for a longer time. These anniversaries are really made excuses for *saké*-drinking rather than true testimonials of respect.

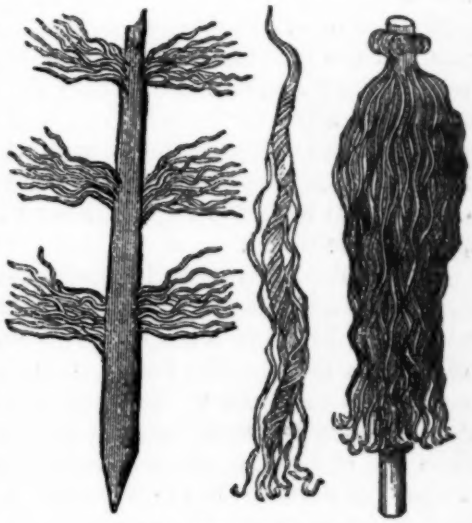

FIG. 2.—INAO OF THE AINU.

The *inao* spoken of above are whittled willow sticks with pendent, curl-like shavings, offerings given to the gods (with the

libations of *saké*) at the time of worship. Miss Bird (volume ii, p. 86) gives an illustration of them and calls them "Aino gods." I think this is a mistake, just as it would be a mistake to call the images, relics, etc., in a Romish church "gods" in the sense of being possessed of absolute power in themselves. One large *inao* is always placed at the eastern end of the hut for the sun-god, and many of them are hung all round the inside of the hut; generally one or more are stuck into the fireplace; and there is always at least one at every spring of water. At least one will be placed at the head of a man's grave; and several will be stuck into the ground at the rude wicket on which are impaled the skulls of bears—these animals occupying a somewhat anomalous place in Ainu philosophy; at one time feared and worshiped, at another killed and eaten.

Although the Ainu ideas of a future existence are very hazy, yet they consider that the spirits of men are well-disposed toward the living, and may be relied upon to bring good fortune to the village and the inhabitants thereof; hence they have no fear of the spirits of men; but it is very different with those of old women. They are considered to be very malignant—witches, in fact—who are seeking some means of working mischief. Formerly this prejudice was more deeply rooted than at present, and, in order to prevent the spirits of old women bewitching the place and the people, their houses were burned down as soon as ever the corpse was taken away for burial. This was done in order that the spirit might have no abiding-place, and, while engaged in hunting for its home, would be diverted from its malicious plans. This notion corresponds with the superstitions of barbarous nations in other parts of the world.

There does not seem to have ever been any superstition connected with the fireplace, as to the manner of procuring the flame when first kindling a fire in a new house, nor as to the necessity of always keeping the fire alight to ward off misfortune. Charcoal is not used, and as the wood is generally in small pieces, the fire is easily extinguished, but this does not bring any bad luck. The use of the Japanese *hibachi* (brazier) and small fire-pots is becoming popular, but this is such a purely exotic custom as not to deserve mention. Formerly the Ainu used the fire-drill, in all essentials similar to that of the Esquimaux of North America; but for many years matches (at first imported from America and Europe, but now manufactured in enormous quantities in Japan) have been so cheap that even the Ainu can use them.

The Ainu bear-feast has been so often described, and the prominent features thereof so well portrayed by others, that I will not attempt to do more than mention one or two points which have not, I think, been given already, only repeating that the

festival of killing and eating the bear, which has been kept in a cage since its capture when a cub, is a sort of religious affair, and is made the occasion for much *saké*-drinking, and that a curious dance is performed, in which men alone take part. The feast is held in February or March (I do not make this statement in absolute contradiction of what Miss Bird says, but admit that custom may vary the time in different villages). Among the northeastern Ainu, Kusuri, and Nemuro, the women, who are officiating as cooks and attendants, provide large vessels of wild strawberries (which must be kept over from the preceding summer), mix the juice with water, and smear the faces of all the people who are present, even to the alien guests. All must submit, as a token of friendliness. This is a strange custom, and is possibly done to indicate that the bear-feast resembles something of a bloody sacrifice, for the Ainu say that the strawberry is used because the color of its juice approaches that of blood.

I will close my rambling notes on these people by an account of what I saw in one or two of their villages on the day of the eclipse of the sun (August 19, 1887). First let me say that they think an eclipse is the effect of great sickness, which causes the sun's face to become black, as does a human being's (sometimes) when in a fit or on fainting away. I left the village of Horobetsu, on the south coast of Yezo, at about two o'clock. It was evident that the Ainu had been told of the impending disaster, for many of them were standing outside of their huts, glancing anxiously at the sun from time to time, and talking together in low, earnest tones which betrayed their apprehension. When we reached the next village, Washibetsu, the shadow of the moon had covered a good-sized segment of the sun, and the people were greatly excited. Many men were looking at the sun and moving their lips as if praying, while some had brought dishes of water, and were throwing the water toward the sun with their mustache-lifters and *inao*, just as we would dash it in the face of a person who had fainted away, to revive him. By the time we arrived at Mororan, the next village, the eclipse was all over; the excitement had pretty nearly subsided, although a few persons were watching the sun rather closely, as if afraid that he might have a relapse and require to be revived again.

As I have tried not to go over ground which has been well worked by previous observers, I have omitted many details of the Ainu manners and customs, and it seems proper for me to give a list of books and publications, which may be referred to by those whose interest will have been sufficiently aroused to make them anxious to know more of the "Hairy People of Japan":

"Transactions of the Asiatic Society of Japan." In many numbers there are articles of more or less interest. Special attention

is called to "Notes on the Ainu." By J. Batchelor. Vol. x, part ii.

"The Japan Weekly Mail." Yokohama. This newspaper contains many valuable articles on the ethnology of Japan in general, and the Ainu in particular.

"The Language, Mythology, and Geographical Nomenclature of Japan. Viewed in the Light of Aino Studies, including a Grammar of the Aino Language, by J. Batchelor." By Basil Hall Chamberlain. Memoirs of the Literature College, Imperial University of Japan. No. 1. Tōkyō, 1887.

"Unbeaten Tracks in Japan." By Isabella L. Bird. London, 1882. Two vols. The second volume contains a graphic and picturesque account of the author's sojourn among the Ainu.

"The Stone Age in Japan." By John Milne. Paper published in the "Journal of the Anthropological Society," May, 1881.

"Der Baerencultus und die Baerenfeste der Ainos, mit einigen Bemerkungen ueber die Taenze derselben." By Dr. B. Scheube. Paper published in the "Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens." December, 1880. Treats of Ainu bear-wishop and dancing.

"Die Ainos." By Dr. B. Scheube. Paper published in the "Mittheilungen der deutschen Gesellschaft für Natur- und Völkerkunde Ostasiens." February, 1882.

"Ethnologische Studien über die Aino auf der Insel Yesso." By Heinrich von Siebold. Berlin, 1881. Illustrated.

"Japan in Yezo." By T. W. Blakiston. Yokohama, 1883.

"Reisen und Forschungen im Amurlande." By L. von Schrenck. Vol. iii contains much valuable information about the Ainu, gathered from many sources.

THE PROLONGATION OF HUMAN LIFE.

By CLEMENT MILTON HAMMOND.

IN order that one may live to near the limit in years of human life, must he inherit some peculiar qualities? Must he conform his habits to some set rules? Must he eat and drink certain things and abstain from certain others? Or, does it all depend upon a series of indeterminable accidents?

There have been many theories, and perhaps a pageful of facts, given to the world upon the subject during the past few centuries, but no thorough, systematic study of these questions has been made. All that we know about the things that seem to govern the length of man's life is what we have learned from limited observation and the small number of cases that have been imperfectly recorded in history or in medical works. It occurred

to me that if accurate statistics could be collected about one thousand men and women, over eighty years of age, living in New England to-day, such information would form the basis of some very interesting and very valuable conclusions. In my position as associate editor of the "Boston Globe" I found this a comparatively easy task. I had five thousand blanks printed, asking for the following information in relation to men and women over eighty:

Name, residence, age, nationality; whether married or single; general description, including size, weight, complexion, etc.; children, how many, ages, state of health, etc.; habits, hours of rising, retiring, meals, exercise, etc.; occupations, past and present; food and drink, quantity, kind, etc.; attacks of sickness if any, and at what ages, nature of disease, etc.; condition of teeth, hair, beard, skin, etc., at time when seen by the correspondent; age at which father and mother died, and of grandfather and grandmother, whenever possible.

These blanks were sent to the representatives of the paper in all parts of New England, accompanied by a letter of explanation which cautioned them to be accurate rather than enterprising. More than three thousand five hundred of these blanks were filled out and returned in the course of two months, and the story that they tell I will try to give in outline.

Every county in Massachusetts, and nearly every county in the whole of New England, is represented in these returned blanks. Some of these old people live on the sea-coast, some on the lowlands of the Connecticut and its tributaries, some among the Berkshire Hills, White and Green Mountains, some upon the sands of Cape Cod, some among the pine-woods of Maine, and others in the manufacturing cities and towns. The canvass has not, of course, been complete, but it has been as complete in the cities as in the towns and on the farms, as complete in one section as in another, as complete among one class as among another. If these three thousand five hundred instances prove anything—and I think no one will dispute that they do—many of the commonly accepted theories would be overturned, and strange facts take their places.

In looking through these blanks, the first thing noticeable is that few of New England's old people have remained unmarried throughout life, the total being less than five per cent. The ratio of unmarried women to unmarried men is about three to one, and, taking married and single together, the women exceed the men by 251. In Massachusetts the list shows that the women exceed the men by 450; in the other States the men exceed the women. The great majority of both men and women have been married only once, usually in early life. The average number of children as a

result of these unions is five, and those children now living are generally recorded in the blanks as healthy.

The fact that in Massachusetts, taking the whole population into account, the women exceed the men by several thousand, accounts in some degree for the greater number of old women, but not, certainly, for anything like half of the excess over the men. I attribute this excess to the fact that during the past half-century the bulk of the population of Massachusetts has been on the seaboard, and a large number of the men have been fishermen and mariners. Because of the great loss of life among this class, especially before the time of steamships and during the palmy days of the whale-fishery, the male population shrank in numbers below the normal level, this showing most strikingly in a list of old people.

Another very peculiar thing revealed by this canvass is the fact that five out of six of these New England old folks have a light complexion, with blue or gray eyes, and abundant brown hair. In stature the men are mostly tall and the women of medium height; in weight the men range from 100 to 160 pounds, with a few of 200 and over, and the women from 100 to 120, with exceptional cases of 180 and over. Throughout life the men have been bony and muscular, the women exactly opposite. The condition of the hair, teeth, beard, and skin of these old people at the time when the blanks were filled out was recorded in about 2,500 instances. In nearly all the hair remains thick, the teeth are very poor or entirely gone, the skin is only slightly wrinkled, and very few of the men wear any beard. In many instances the correspondents speak of the skin as being "fair, soft, smooth, and moist." One case is given, that of a man of eighty-nine, from whose mouth not a tooth has been lost. In most instances of those not over ninety the eye-sight is still good, and in dozens of cases it is pronounced "remarkably good."

HABITS.—The information which the blanks give on the subject of habits coincides with the opinion of most people, formed from observation, that longevity without regularity of habits is rare. These old people, men and women alike, are put down as early risers and retirers, almost without exception, and fully nineteen out of every twenty have observed this custom throughout life, except perhaps at some short period in youth. Meals have been eaten regularly, three each day, with dinner at noon, the exceptions being so rare as to indicate nothing. Exercise in most cases has been hard work up to sixty-five or seventy, and after that period has consisted (when the regular occupation has been given up) of walking, gardening, or both. Except in cases of sickness these old people are as a rule as active and as fond of constant occupation of some sort to-day as most men and women are at thirty-five.

OCCUPATIONS.—One of the most significant facts gathered in this canvass is that regarding occupations. Out of 1,000 men, throughout life 461 have been farmers; 92 have been carpenters; 70, merchants; 61, mariners; 49, laborers; 42, shoemakers; 41, manufacturers; 23, clergymen; 23, masons; 16, blacksmiths; 16, bankers; 12 each, iron-workers, mill-hands, physicians, and lawyers; and the rest are divided among nearly all the other trades and professions. The list includes only one each of the following: Hermit, hunter, chemist, professor, soldier, broker, auctioneer, jockey, contractor. Nearly all, however, began life upon the farm.

Eight hundred out of twelve hundred women have been farmers' wives, and all but about fifty of the remainder have been housewives. Four women only, all unmarried, have supported themselves through life by inherited wealth, and are now aged respectively eighty-two, eighty-three, eighty-six, and ninety. Three other unmarried women have been milliners, and six, one unmarried, have been dress-makers. Seven, two unmarried, have been nurses. Six, two unmarried, have been school-teachers.

Among the hundreds of remarkable instances which illustrate constancy of occupation cited by the correspondents are a few that I can not refrain from giving, because I believe that they point to a very important fact, and at the same time make most interesting reading:

Elijah Tolman, of Brockton, Mass., is eighty-five, and was a stage-driver for thirty years. For the past seven years he has worked in charge of a coal-office, and has been but one day from his duties in that time.

Andrew Stetson, of Duxbury, Mass., is ninety-five, and was constantly employed all his life making shoes until one year ago.

Aaron Farnham, of Cambridge, Mass., aged eighty-seven, sold Bibles in Vermont for seventy years.

Daniel Bigelow, of Athol, Mass., now eighty-seven, has worked as a farmer for seventy-seven years, and mowed grass with a scythe for seven tons of hay the past summer.

William E. Cook, of Portsmouth, R. I., is eighty-nine, a blacksmith, and still works in his shop six days each week.

Ira Chamberlain, of Bangor, Me., aged ninety-five, worked at the tailor's trade until his last birthday.

Thaddeus Rising, of Hatfield, Mass., is eighty, and works daily, as he has for the past sixty years, at his trade of whip-maker.

Mrs. Jane Huntress, of Augusta, Me., ninety-two years of age, still does her own cooking, washing, ironing, and garden-work. Since she was fifty-five she has earned the money for and built a fine house, going herself to the mill and selecting the lumber, and superintending the building operations. She is one of twelve children, all born without the aid of a physician.

FOOD—DRINK—STIMULANTS.—The blanks tell one simple story, with so few variations as to be positively monotonous, in relation to the food eaten by these old people. The diet has been regular New England home-dishes of meat, vegetables, and pastry, with breakfast early, dinner at noon, and supper late. Very few are mentioned as small eaters or large eaters; most are mentioned as not particular, with good appetites through life. A half-dozen never eat meat, and two have abstained from water. More than two thirds have been habitual users of tea and coffee, and of the remainder nearly all have drunk tea. Few of the men, and none of the women, are given as users of more intoxicating beverages than cider, and not a dozen out of all have ever used liquors to excess. Ten of the women are mentioned as habitual smokers, and a score as snuff-takers. Of the men, a large majority have used tobacco—either chewing, smoking, or both. Most of the tobacco-users have been moderate, although numbers of cases are given where the amount consumed is enormous, and continued constantly up to the time when the census was taken. A few broke away from the habit after it had lasted for twenty, thirty, or fifty years, and have now been without the narcotic for perhaps a decade or more.

SICKNESS.—The record of sickness is so varied that scarcely half a dozen cases are alike out of the whole long list, except where there has been no illness other than the usual complaints of infancy.

Out of 1,049 men, 382 never were ill since early childhood; and of 880 women, 286 have enjoyed the same good health. One hundred and fourteen men and 171 women have had petty diseases only, and 495 men and 402 women have been seriously ill. The serious illness of the majority was a fever of some sort, typhoid heading the list. The other diseases are as numerous almost as the individuals afflicted, running from Asiatic cholera to shingles, and the attacks have been at all periods of life. As might be supposed, rheumatism is the most general complaint, usually in conjunction with other diseases. Locality seems to have had no influence on sickness, the same disorders appearing on high land and on low land, on dry land and on moist land, in the interior and by the sea-shore.

PARENTS AND CHILDREN.—The average age reached by the parents and grandparents, taken together, of these old people was about sixty-five, and in few instances have both the father and mother or the grandfathers and grandmothers died under fifty, although in many cases—about twenty-five per cent—either the father or the mother has died before reaching this age. Not over one third of the children of these aged people have reached middle life, and about one half died either in infancy or before thirty,

and about one fourth only are still living. The health of the latter, however, is in almost every instance put down as good. The blanks do not tell what would, perhaps, be a valuable thing—how many brothers and sisters the subjects had, and whether or not they died young; it appears, though, from the names, that few members of the same family have survived, unless it is supposed that the remaining members were older and have died, or enough younger to come under the eighty-year limit.

SOME CONCLUSIONS.—Perhaps it is true that only an expert or a philosopher should draw conclusions. I pretend to be neither one nor the other, yet I think a familiarity with the facts gathered about these hundreds of old people will excuse anything on my part that might at first thought look like presumption. What I have tried to learn from this vast amount of information that has been collected about these examples of long life are these things:

What is the influence of the different occupations upon length of life?

Does the physical build of a person have anything to do with the length of his life?

Can one so regulate his habits of work, sleep, eating, drinking, use of stimulants and narcotics, and exercise, as to prolong life?

Is there such a thing as an inherited tendency to long or short life?

Few of the people accounted for by this census are employés, unless the housewives be called such, and in New England I certainly think they can not be. The occupation that claims most of the men is farming, which means dependence on circumstances and not on men. Of the men and women alike, throughout the list, they are the exceptions who have not been weighted with responsibilities, but responsibilities which, by being borne without intermission, have become fixed habit. The fact that so many of these old people are not employés, considered in conjunction with the fact that the great mass of mankind is made up of wage-workers, points toward a very important conclusion. It seems evident either that a man with the elements of long life within him is more independent in his nature or that a spirit of independence fostered for years tends to prolong existence. It needs no collection of statistics to prove that, in most cases, one who works during a long period for another has a weaker individuality than he who is an employer. The brain of the wage-worker may weigh and measure as much, and his physical strength may be as great, as his who takes the risk of profit and loss upon himself, but in New England, at least, his life is not so long as the average, and it is rare, as the statistics show, that he lives beyond the age of eighty. This result can not, certainly, be due in any

considerable degree to amount of labor, to irregularity, or in any degree whatever to care—supposed to be so deadly in its effect—or to want of nourishing food.

I doubt also if any well-informed person will claim that sanitary conditions have any influence, certainly not if he knows as much as I do of the conditions under which the bulk of these people whom we are considering live.

Very few instances are given where occupations were changed except in the cases of the mariners, who have mostly become farmers in a small way. The life of nearly all these people has been what is usually considered a monotonous one, with regular hours of steady labor and moderately sure returns. Few appear to have taken many risks in life, and while most of them have carried more than the average New-Englander's share of mental and physical burdens, these burdens have been so evenly distributed throughout life that the strain has not been jerky. Surely the housewife has more cares than the woman who works in a shop or as a house-servant, and yet her cares are so similar day after day and year after year that they become easy to bear. So also with the farmer compared with the clerk or mill-hand. Few in all the list have been either more or less than moderately successful—successful above the average, to be sure, but they have achieved neither notoriety nor wealth. They have, in fact, been placed above the wasting worry of want, and have, on the other hand, escaped the softening of the tissues and aimlessness of purpose that generally accompany wealth easily and rapidly obtained.

I have alluded to the fact that in the subjects of the census the complexion in most instances is light. While this may be due to the northern origin of the majority of New England people, and have no special bearing upon the subject of longevity, it may possibly be very important as showing the effect of temperament upon the length of life. That the sanguine temperament predominates in these people is undoubtedly a fact, and it appears that the sanguine-nervous (judged from complexion, color of the eyes, and general build) is most common. In theory, certainly, this temperament is that which would most conduce to longevity. Other facts, of the nature of these gathered in New England, from some other locality, might offset these and disprove the theory; but, until these other facts are gathered, I think the theory that people with nervous-sanguine temperaments, and the two nicely blended, are liable to live longer than those who possess a nervous-bilious or a bilious-lymphatic temperament, with either predominating, is strong enough to work with; and, while it does not directly teach us how to live longer, it points to something in the future that means a great deal to the human race.

The fact that the majority of the men are bony and muscular, and the women plump, is easily explained, I think, by the occupations. In the work of the men their muscles have been brought into play so much, and have used such a large proportion of the nourishment taken into the system, that fat could not accumulate. With the women the reverse has been true, especially after they reached the age of fifty, when grown-up daughters took the hardest of the work from their mothers' shoulders.

In regard to food, the evidence is so uniformly one way that those who advise a simple diet, and those who cry out against meat, must either hold their theories to be above facts or give them up. There is certainly nothing "simple" about the diet of a New England farmer. It consists of salt and fresh pork and beef and all sorts of common fish and vegetables, almost always poorly cooked, and pies and cakes of the most indigestible sorts. The food is "plain," truly, and gives the digestive organs an abundance of work to do, but it is not such food as a theorist would recommend to one who desired to live near up to the century-mark. Tea and coffee have certainly proved that they do not tend to shorten life, even if they do not prove that they help to prolong it. The generally accepted theory in relation to stimulants, that in excess they are not life-sustaining, receives strong support. Tobacco appears to prove itself harmless, at least on the temperament of these people. Whether it be a help to live long requires other evidence.

While the farmers of New England and their wives are a cleanly people, they are not much given to bathing. This neglect may not have prolonged their existence or made them more healthy, but it is to be presumed that it has not cut off many years or caused much disease. Neither are the members of these households well informed in relation to sanitary matters. They know little of the unseen dampness to which the human system is so constantly exposed, and, knowing little, care little. May not this be an influence in favor of a prolonged existence, paradoxical as the supposition may seem? In Hingham, Mass., with only four thousand inhabitants, there are eighty people over eighty years of age, and out of these seventy-five are of light complexion. In no other town in New England, so far as could be learned, is there such a proportion of old people. This town is on the sea-coast, lies very low, is without sewers, and has only recently put in a system of water-works. From a sanitary point of view the conditions here are about as unfavorable to long life as could be conceived outside the crowded portions of the large cities. And in Boston, where the sanitary conditions appear to be the worst—in the North End and South Boston districts—the greatest number of very old people are found.

From the hours of retiring and rising given I judge the average length of sleep to be about eight hours, with few exceptions. Regularity in hours of work, eating, sleeping, and everything in fact, seems to have been rigidly observed. But is not this more the result of the temperament than the cause of long life? Is not the nervous-sanguine temperament more than any other like a balance-wheel or the pendulum of a clock? Is it not, after all, the great regulator of which the habits of these people are a manifestation, and to which is due their long life? And is it not something more than a regulator; is it not a repairer of waste and decay, a remedy more potent than any drug? I will not presume to answer these questions, for some of my more learned medical friends should be much better able to do so in spite of these new facts which I have.

Without more accurate and more complete information in relation to the ages of the parents, grandparents, great-grandparents, and the brothers and sisters of these people in question, it is very difficult to make any deductions pertaining to hereditary longevity. Out of all the statistics that have been gathered there are none which are full or accurate enough to base any theory upon, other than that a *tendency* to long life *may* be transmitted from parents to children. To gather the necessary statistics in relation to, say, one thousand people, from eighty to ninety, would be extremely difficult, but it must be done before scientific thinkers can make deductions.

In order to mention all of the really remarkable things shown by this collection of facts, I should be obliged to make a serial of this article. I have tried to mention those only which seemed most interesting and important. One thing, to me, seems to stand out above all others: that a strong vital principle, manifested outwardly by firm build and constant activity, has been the chief cause of the advanced age of these people. Given a certain organization of mind and body, I think that a man may count on long life—always barring accidents—with reasonable certainty. Such an organization need not be put under any particular conditions of life; it will seek them out for itself, as a plant seeks out in the earth and the air such elements as aid its development. There is no reason that science can see why a raven should live longer than a snipe, but there is a reason, nevertheless: so we can see no reason why a tall, bony, muscular, light-skinned farmer should live longer than a short, stout, dark-skinned clerk; but I believe there is one, and one that science may some day discover.

I have one suggestion to make: that our national Government, when it takes the next general census, include in its statistics information about all the people in the United States above ninety, the kind of information to be determined beforehand by the most

eminent physicians and scientific men generally in this country or in the world. I believe that such information would be of more value to the world, after having been properly digested, than all the facts about the manufacture of cotton cloth, the raising of tobacco, the production of whisky, etc., that could be collected in a century. For do we not all desire to live long ?

PROBLEMATICAL ORGANS OF SENSE.*

By Sir JOHN LUBBOCK.

IN addition to the organs of which I have attempted in the preceding chapters to give some idea, and to those which from their structure we may suppose to perform analogous functions, there are others of considerable importance and complexity, which are evidently organs of some sense, but the use and purpose of which are still unknown.

"It is almost impossible," says Gegenbaur,† "to say what is the physiological duty of a number of organs, which are clearly sensory, and are connected with the integument. These enlargements are generally formed by ciliated regions to which a nerve passes, and at which it often forms enlargements. It is doubtful what part of the surrounding medium acts on these organs, and we have to make a somewhat far-fetched analogy to be able to regard them as olfactory organs."

Among the structures of which the use is still quite uncertain are the muciferous canals of fishes. The skin of fishes, indeed, contains a whole series of organs of whose functions we know little. As regards the muciferous canal, Schultze has suggested‡ that it is a sense-organ adapted to receive vibrations of the water with wave-lengths too great to be perceived as ordinary sounds. Beard also leans to this same view. However this may be, it is remarkably developed in many deep-sea fish.

In some cases peculiar eye-like bodies are developed in connection (though not exclusively so) with the muciferous canal. Leuckart,§ by whom they were discovered, at first considered them to be accessory eyes, but subsequent researches led him to modify this opinion, and to regard them as luminous organs.

* From "The Senses, Instincts, and Intelligence of Animals," by Sir John Lubbock. "International Scientific Series," vol. lxiv, in press by D. Appleton & Co.

† "Elements of Comparative Anatomy."

‡ "Ueber die Sinnesorgane der Seitenlinie bei Fischen und Amphibien," "Arch. für mic. Anat.," 1870.

§ "Ueber muthmassliche Nebenaugen bei einem Fische." Bericht über die 39 Vers., "Deutscher Naturforscher," Giessen, 1864.

Ussow* has more recently maintained that they are eyes, and Leydig considers them as organs which approach very nearly to true eyes ("welche wirklichen Sehorganen sehr nahe stehen"). Whatever doubt there may be whether they have any power of sight, there is no longer any question but that they are luminous, and they are especially developed in the fishes of the deep sea.

These are very peculiar. The abysses of the ocean are quite still, and black darkness reigns. The pressure of the water is also very great.

Hence the deep seas have a peculiar fauna of their own. Surface species could not generally bear the enormous pressure, and do not descend to any great depth. The true deep-sea forms are, however, as yet little known. They are but seldom seen, and when obtained are generally in a bad state of preservation. Their tissues seem to be unusually lax, and liable to destruction. Moreover, in every living organism, besides those usually present in the digestive organs, the blood and other fluids contain gases in solution. These, of course, expand when the pressure is diminished, and tend to rupture the tissues. The circumstances under which some deep-sea fish have occasionally been met with on the surface bears this out. They are generally found to have perished while endeavoring to swallow some prey not much smaller, or even in some cases larger, than themselves. What, then, has happened? During the struggle they were carried into an upper layer of water. Immediately the gases within them began to expand, and raised them higher; the process continued, and they were carried up more and more rapidly, until they reached the surface in a dying condition.†

It is, however, but rarely that deep-sea fish are found thus floating on the surface, and our knowledge of them is mainly derived from the dredge, and especially from the specimens thus obtained during the voyage of the Challenger.

In other respects, moreover, their conditions of life in the ocean-depths are very peculiar. The light of the sun can not penetrate beyond about two hundred fathoms; deeper than this, complete darkness prevails. Hence in many species the eyes have more or less completely disappeared. In others, on the contrary, they are well developed, and these may be said to be a light to themselves. In some species there are a number of luminous organs arranged within the area of, and in relation to, the muciferous system; while in others they are variously situated. These luminous organs were first mentioned by Cocco.‡ They have since been stud-

* "Ueber den Bau der sog. augenähnlichen Flecken einiger Knochenfische," "Bull. Soc. Imp. Moscow," 1879.

† Günther, "Introduction to the Study of Fishes."

‡ "Nuovi Ann. dei Sci. Nat.," 1838.

ied by Günther, Leuckart, Ussow, Leydig, and Emery. Lastly, they have been carefully described by Günther, Moseley, and von Lendenfeld, in the work on "Deep-sea Fishes," in vol. xxvii of the "Challenger Reports." The deep-sea fish are either silvery, pink, or in many cases black, sometimes relieved with scarlet, and, when the luminous organs flash out, must present a very remarkable appearance.

We have still much to learn as to the structure and functions of these organs, but there are cases in which their use can be surmised with some probability. The light is evidently under the will of the fish. It is easy to imagine a Photichthys (Fig. 1) swimming

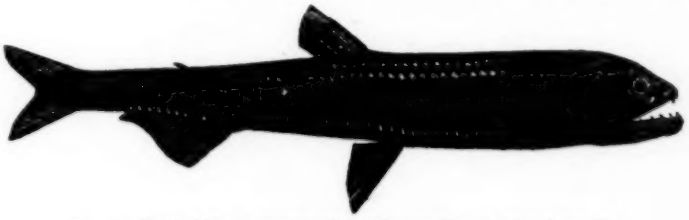

FIG. 1.—*Photichthys argenteus* ("Challenger Reports," vol. xxvii).

in the black depths of the ocean, suddenly flashing out light from its luminous organs, and thus bringing into view any prey which may be near; while, if danger is disclosed, the light is again at once extinguished. It may be observed that the largest of these organs is situated just under the eye, so that the fish is actually provided with a bull's-eye lantern. In other cases the light may rather serve as a defense, some having—as, for instance, in the genus *Scopelus*—a pair of large ones in the tail, so that "a strong ray of light shot forth from the stern-chaser may dazzle and frighten an enemy."* In other cases they probably serve as lures. The "sea-devil," or "angler" of our coasts, has on its head three long, very flexible, reddish filaments, while all round its head are fringed appendages, closely resembling fronds of sea-weed. The fish conceals itself at the bottom, in the sand or among sea-weed, and dangles the long filaments in front of its mouth. Other little fishes, taking them for worms, unsuspectingly approach, and themselves fall victims.

Several species of the same family live at great depths, and have very similar habits. A mere red filament would, however, be invisible in the dark, and therefore useless. They have, however, developed (Fig. 2) a luminous organ, a living "glow-lamp," at the end of the filament, which doubtless proves a very effective lure.†

These cases, however, though very interesting, throw little light on the use of the muciferous system in ordinary fish, which, I think, still remains an enigma.

* Günther ("Challenger Reports," vol. xxvii). † Günther, "Study of Fishes."

In some of the lower animals the nerves terminate on reaching the skin at the base of rod-like structures similar, in many respects, to the rods of the retina, or the auditory rods of the ear, and of which it is very difficult to say whether they are organs of touch or of some higher sense.

Round the margin of the common sea-anemone is a circle of bright blue spots, or small bladders. If a section be made, there

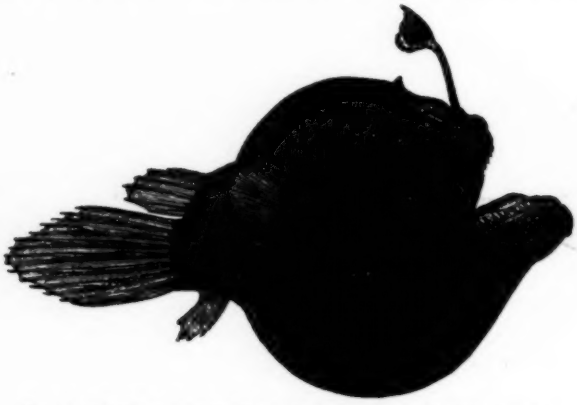

FIG. 2.—*Ceratius bispinosus* ("Challenger Reports," vol. xxvii).

will be found a number of cylindrical organs, each containing a fine thread, and terminating in a "cnidocil"; and, secondly, fibers very like nerve-threads, swelling from time to time with ganglionic expansions, and also terminating in a cnidocil. These structures, in all probability, serve as an organ of sense, but what impressions they convey it is impossible to say.

Some jelly-fishes (*Trachynemadæ*) have groups of long hairs arranged in pairs at the base of the tentacles (Fig. 3), which have been regarded as organs of touch, and it is certainly difficult to suggest any other function for them. They are obviously sense-hairs, but I see no reason for attributing them to the sense of touch.

The so-called eyes of the leech, in Leydig's* opinion, which is confirmed by Ranke,† are also developed from the supposed special organs of touch. The latter are much more numerous, as many as sixty being developed on the head alone. They are cylindrical organs, lined with large nucleated refractive cells, which occupy nearly all the interior. A special nerve penetrates each, and, after passing some way up, appears to terminate in a free end.

I may also allude to the very varied bristles and cirrhi of worms, with their great diversity of forms.

* "Die Augen und neue Sinnesorgane der Egel," "Reichert's Arch.," 1861.

† "Beit. zu der Lehre von den Uebergangs-Sinnesorganen," "Zeit. für wiss. Zool.," 1875.

Among insects and crustacea there are a great number of peculiarly formed skin appendages, for which it is very difficult to suggest any probable function.

The lower antennæ of the male in Gammarus, for instance, bear a very peculiar slipper-shaped organ, situated on a short

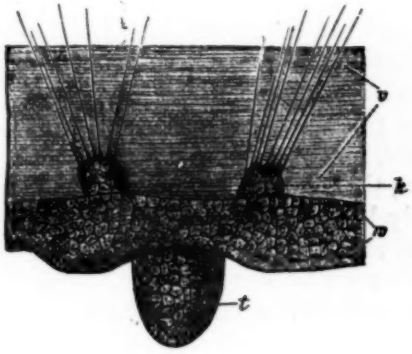

FIG. 3.—EDGE OF A PORTION OF THE MANTLE OF *Aglaura hemistoma*, WITH A PAIR OF SENSE-ORGANS (after Hertwig). *v*, velum; *k*, sense-organ; *ro*, layer of nettle-cells; *t*, tentacle.

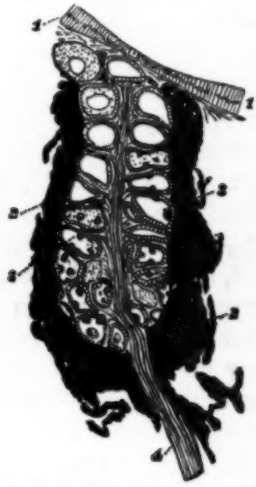

FIG. 4.—SENSE-ORGAN OF LEECH (from Carrière, after Ranke). 1, epithelium; 2, pigment; 3, cells; 4, nerve. The longer axis equals ·4 mm.

stalk: this was first mentioned by Milne-Edwards, and subsequently by other authors, especially by Leydig.* The short stalk contains a canal, which appears to divide into radiating branches on reaching the "slipper," which itself is marked by a series of rings.

Among other problematical organs, I might refer to the remarkable pyriform sensory organs on the antennæ of Pleuromma,† the appendages on the second thoracic leg of Serolis, those on the maxillipeds of Eurycopa, on the metatarsus of spiders, the finger-shaped organ on the antennæ of Polydesmus, the singular pleural eye (?) of Pleuromma, and many others.

There is every reason to hope that future studies will throw much light on these interesting structures. We may, no doubt, expect much from the improvement in our microscopes, the use of new reagents, and of mechanical appliances, such as the microtome; but the ultimate atoms of which matter is composed are so infinitesimally minute, that it is difficult to foresee any manner in which we may hope for a final solution of these problems.

Loschmidt, who has since been confirmed by Stoney and Sir W. Thomson, calculates that each of the ultimate atoms of matter

* "Zeit. für wiss. Zool.," 1878.

† Brady, "On the Copepoda of the Challenger Expedition," vol. viii.

is at most $\frac{1}{5000000}$ of an inch in diameter. Under these circumstances we can not, it would seem, hope at present for any great increase of our knowledge of atoms by improvements in the microscope. With our present instruments we can perceive lines ruled on glass which are $\frac{1}{70000}$ of an inch apart. But, owing to the properties of light itself, the fringes due to interference begin to produce confusion at distances of $\frac{1}{140000}$, and in the brightest part of the spectrum, at little more than $\frac{1}{90000}$, they would make the obscurity more or less complete. If, indeed, we could use the blue rays by themselves, their waves being much shorter, the limit of possible visibility might be extended to $\frac{1}{180000}$; and, as Helmholtz has suggested, this perhaps accounts for Stinde having actually been able to obtain a photographic image of lines only $\frac{1}{100000}$ of an inch apart. This, however, would appear to be the limit, and it would seem, then, that, owing to the physical characters of light, we can scarcely hope for any great improvement so far as the mere visibility of structure is concerned, though in other respects, no doubt, much may be hoped for. At the same time Dallinger and Royston Pigott have shown that, as far as the mere presence of simple objects is concerned, bodies of even smaller dimensions can be perceived. According to the views of Helmholtz, the smallest particle that could be distinctly defined, when associated with others, is about $\frac{1}{80000}$ of an inch in diameter. Now, it has been estimated that a particle of albumen of this size contains 125,000,000 molecules. In the case of such a simple compound as water, the number would be no less than 8,000,000,000. Even then, if we could construct microscopes far more powerful than any we now possess, they could not enable us to obtain by direct vision any idea of the ultimate molecules of matter. The smallest sphere of organic matter which could be clearly defined with our most powerful microscopes may be, in reality, very complex; may be built up of many millions of molecules, and it follows that there may be an almost infinite number of structural characters in organic tissues which we can at present foresee no mode of examining.

Again, it has been shown that animals hear sounds which are beyond the range of our hearing, and that they can perceive the ultra-violet rays which are invisible to our eyes.*

Now, as every ray of homogeneous light which we can perceive at all appears to us as a distinct color, it becomes probable that these ultra-violet rays must make themselves apparent to the ants as a distinct and separate color (of which we can form no idea), but as different from the rest as red is from yellow, or green from violet. The question also arises whether white light to these insects would differ from our white light in containing this addi-

* "Ants, Bees, and Wasps."

tional color. At any rate, as few of the colors in nature are pure, but almost all arise from the combination of rays of different wave-lengths, and as in such cases the visible resultant would be composed not only of the rays we see, but of these and the ultra-violet, it would appear that the colors of objects and the general aspect of nature must present to animals a very different appearance from what it does to us.

These considerations can not but raise the reflection how different the world may—I was going to say must—appear to other animals from what it does to us. Sound is the sensation produced on us when the vibrations of the air strike on the drum of our ear. When they are few, the sound is deep; as they increase in number, it becomes shriller and shriller; but when they reach forty thousand in a second they cease to be audible. Light is the effect produced on us when waves of light strike on the eye. When four hundred millions of millions of vibrations of ether strike the retina in a second, they produce red, and as the number increases the color passes into orange, then yellow, green, blue, and violet. But between forty thousand vibrations in a second and four hundred millions of millions we have no organ of sense capable of receiving the impression. Yet between these limits any number of sensations may exist. We have five senses, and sometimes fancy that no others are possible. But it is obvious that we can not measure the infinite by our own narrow limitations.

Moreover, looking at the question from the other side, we find in animals complex organs of sense, richly supplied with nerves, but the function of which we are as yet powerless to explain. There may be fifty other senses as different from ours as sound is from sight; and even within the boundaries of our own senses there may be endless sounds which we can not hear, and colors, as different as red from green, of which we have no conception. These and a thousand other questions remain for solution. The familiar world which surrounds us may be a totally different place to other animals. To them it may be full of music which we can not hear, of color which we can not see, of sensations which we can not conceive. To place stuffed birds and beasts in glass cages, to arrange insects in cabinets, and dried plants in drawers, is merely the drudgery and preliminary of study; to watch their habits, to understand their relations to one another, to study their instincts and intelligence, to ascertain their adaptations and their relations to the forces of nature, to realize what the world appears to them—these constitute, as it seems to me at least, the true interest of natural history, and may even give us the clew to senses and perceptions of which at present we have no conception.

FOUR-HANDED SINNERS: A ZOÖLOGICAL STUDY.

By FELIX L. OSWALD, M. D.

EDMOND ABOUT used to tell a good story of a Spanish prelate who studied anatomy for the special purpose of describing the fragments of a miraculous skeleton, but who was so astounded by the discovery of a rudimentary tail-bone that he relinquished his study in dismay, and declined to specify the results of his investigation.

In a similar way the comparative study of human and animal psychology would often surprise a close observer. There was a time when the mere suggestion of such studies would have been overruled by the prevalent tenet which denied the affinity of our mental apparatus to any part of the animal organism, the attribute of "reason" being reserved for the primate of the animal kingdom, while the actions of his humble fellow-creatures were supposed to be prompted by a blind and semi-automatic agency, called "instinct." Intelligence, we were told, might be compared to a "keyed instrument, from which any music it is capable of producing may be called forth at the will of the performer," while the *modus operandi* of instinct was supposed to resemble that of a "barrel-organ, which plays with the greatest exactness a certain number of tunes that are set upon it, but can do nothing else." The mechanism of that living barrel-organ was, moreover, believed to act chiefly in the interest of the species, while reason subserved the interests and momentary caprices of individuals.

The subjective motives of that view were, however, clearly identical with the prejudice which long denied the analogies between the physical organism of men and brutes. Every step in the progress of comparative anatomy has more plainly demonstrated the fact that the alleged contrasts in the construction and the functional characteristics of human and animal bodies are mere differences of degree, and a similar conclusion must force itself upon the unprejudiced observer of animal soul-functions. Even our domestic birds often manifest symptoms of passions, whims, and moral aberrations, clearly analogous to those of their biped proprietors; and in the higher animals those manifestations become so unmistakable that a student of moral zoölogy is often tempted to indorse the view of that school-girl who defined a monkey as "a very small boy with a tail."

According to Arthur Schopenhauer's theory of moral evolution, the conscious prestige of our species first reveals itself in the emotions of headstrong volition that make a little baby stamp its feet and strike down its fists, "*commanding* violently before it

could form anything like a clear conception of its own wants. . . . Untutored barbarians," he adds, "are apt to indulge in similar methods of self-assertion, and, in settling a controversy, prefer menacing gestures to rational explanations."

That tendency, however, is not confined to infants and savages. The black-faced *Cynocephalus maurus* (the "Cutch baboon" of the New York pet-dealers) resents the slightest misunderstanding of his desires, and, after reaching out for a glittering toy, can not be placated by an offered tidbit, but slams down his fist with the dogmatic emphasis of a colored revival-preacher. In his controversies with his cage-mate (a female spaniel) my pet Cutch will lay hold of the dog's tail and enforce his theories with a peremptory pull that never fails to provoke a rough-and-tumble fight; but, long after the dog has relapsed into sullen silence, her antagonist will shake the cage with resounding blows, and every now and then steal a look at the by-standers, to invite their attention to his "best method of dealing with heretics."

Egotism has been defined as the "stout stem of which altruism is the tender flower," and our Darwinian relatives can claim a healthy share of that moral substratum. *Faust-Recht*, the law of the strong hand, is the recognized code of every monkey community. Without the slightest pretext of preliminary explanations the president of a simian syndicate will snatch away the shares of the weaker stockholders and ignore the shrieks of his victims with the eupeptic equanimity of a retired railway nabob. The mere sight of alien property is apt to excite the covetousness of a privileged four-hander. My pig-tail monkey (*Macacus nemestrinus*) can not see a dog gnaw a bone without plotting the appropriation of the unknown dainty, and, even after a series of vain attempts to utilize his booty, will guard his prize in the vague hope of discovering the secret of its value. He sleeps in a tub, but has failed to adopt the cynic tenet of attaining happiness by a reduction of his desires; and whenever he succeeds in pulling the staple of his chain, his barrel gets stuffed with an accumulation of miscellaneous plunder, including such objects of rather limited utility as kite-tails, empty bottles, ice-hooks, feathers, and potsherds. He is fond of taking an inventory of his property by spreading his collection on an open porch, but at such moments regards every intruder with nervous suspicion, and at the approach of a street Arab makes a determined rush to obviate a possible depreciation of his stock.

The acquisitive energy of a monkey-swarm must be witnessed to be credited. In the banana-gardens of the *tierra caliente* a Mexican capuchin monkey will exhaust his business opportunities with the dispatch of a Cincinnati bank-cashier; but, in his attempt to reach the Canadian side of the hedge with a good arm-

ful of plunder, so often falls a victim to the pursuing dogs that monkey-trappers frequently rent an orchard for the special purpose of capturing the retreating marauders.

An equally effective method is that of the Abyssinian pet-hunters, who decoy baboons by imitating the squeal of their youngsters. In spite of their mischievous petulance, nearly all the Old World species of our four-handed kinsmen are emotionally sympathetic, and ever ready to rescue their wounded friends at the risk of their own lives. At the cry of a captured baby-baboon, the whole tribe of passionate four-fisters will rush in, regardless of consequences, and a similar tendency of co-operation may have given our hairy forefathers a superior chance of survival and secured their victory in their struggle for existence against their feline rivals. Their list of original sins may have included gluttony, covetousness, and violence of temper, but hardly a *penchant* for wanton bloodshed. With the exception of the fox-headed lemurs and the ultra-stupid marmosets, nearly all our simian relatives evince symptoms of a character-trait which might be defined as an instinctive aversion to cruelty. Menagerie monkeys indulge their love of gymnastics by frequent scuffles; but the sight of a *bona-fide* fight awakens a chorus of shrieks expressing a general protest rather than an emotion of fear or even of partisan interest, for in an open arena the stouter members of the obstreperous community are sure to rush in and part the combatants. That result, at least, forms a frequent *intermezzo* of the circus-fights at the capital of Baroda (British India), where the sport-loving prince pits all sorts of beasts and birds in single combat, and often diversifies the proceedings by introducing an able-bodied ape.

Like Buddha Sakyamuni, my Cutch baboon extends his compassion to all suffering fellow-creatures. Orphaned kittens or whining puppies straying within reach of his arm risk their lives in his sympathetic embraces. He will hug even crippled rabbits and half-drowned rats, and in his anxiety to relieve their ailments will often resort to the expedient of instituting an entomological inquest, searching their hides for vermin as a possible cause of their distress. One of his temporary playmates, a pot-bellied young Chacma baboon, aggravated his unpopularity by an incurable *penchant* for peculation; but the occasional penalties of his misdeeds were more than outweighed by the demonstrative sympathy of his kinsman, who would snatch up the squealing little monster and coddle him for hours, every now and then voicing his protest against human methods of discipline in a shrill scream, which his young *protégé* never failed to accompany with an approbative grunt.

In Hindostan, where three varieties of sacred monkeys enjoy

the freedom of every town, those four-handed pensioners often assist the police in enforcing the riot-laws by charging *en masse* for the scene of every dog-fight and school-boy scuffle. They will rescue worried cats, and, for greater security, deposit them on the next roof, or suppress rowdyism in general, the stout Rhesus baboon, for instance, being physically as well as morally qualified to quell the aggressive disposition of the fiercest cur. On the platform of a public warehouse the British residents of Agra, a few years ago, witnessed a scene which put that character-trait in even a stronger light. A little street Arab had spread his pallet in the shade of a stack of country produce, and had just dropped asleep, when the proprietor of the Planters' Hotel strolled up with a pet leopard that had learned to accompany him in all his rambles. A troop of tramp monkeys had taken post on the opposite end of the shed, and, like the beggar boy, seemed to enjoy a comfortable *siesta*, but at sight of the speckled intruder the whole gang charged along the platform like a squadron of *spahis*, and, instantly forming a semicircle about the little sleeper, faced the leopard with bristling manes, evidently resolved to defeat the suspected purpose of his visit.

Our four-handed cousins apparently credit their biped kinsmen with reciprocative tendencies. Three years ago a New York pet-dealer shipped me a bonnet-macaque to Tallulah, Ga., where my guest happened to arrive during the temporary absence of the regular express agent. His assistants, in trying to feed the interesting stranger, managed to break the top of the box, and, after taking to their heels, made matters worse by attacking the deserter with stones and brickbats, till he evaded their missiles on the turrets of a three-story hotel. Here a literal "*steeple*-chase" was kept up for hours, with the co-operation of an ever-increasing number of volunteers, till the approach of night obliged me to adopt the plan of a veteran squirrel-hunter, who offered to recapture the fugitive by a "crease-shot"—i. e., to cripple him just enough to compel his surrender. The expedient led to the desired result; but from that day our prisoner behaved like a captive wild cat, bristling up at the approach of every visitor, and wearing out his teeth in a series of desperate attempts to break his wire chain. By dint of perseverance he at last effected his purpose, and once more enacted a declaration of independence; but this time fate was too close on his heels, and, before he had run more than a hundred yards, the dogs obliged him to take refuge in the top of a small pine-bush. On my arrival the leader of his pursuers, a big deer-hound, was assailing that bush with leaps that speedily threatened to make the hostile position untenable, and was just bracing himself for another spring, when the deserter suddenly leaped upon my shoulder, and, clasp-

ing my neck with both arms, invoked my protection in a mumble so expressive and persistent that I had to gratify him by stampeding the dogs.

In the art of gaining allies in a perilous emergency, our four-handed cousins can, indeed, rival the tricks of a Turkish diplomat. Whenever my little Chacma incurred the displeasure of his big relative, he would make common cause with the spaniel by patting his back and expurgating his fur with feverish haste, and, at the approach of the vindictive Cutch, often managed to push his ally to the front and make him stand the brunt of the inevitable scuffle; and when my negro boy-of-all-work once caught him on the top shelf of a cupboard, he at once made a rush for the lap of an incidental visitor, and with screams and excited gestures urged him to treat the young African as a common enemy.

A less pleasant character-trait was his tendency to vent his resentments on impartial by-standers. His morbid passion for chewing-tobacco often induced him to pick the pockets of my mail-carrier, and, after the consequent spanking, he repeatedly sneaked up on the porch to "take it out" of an old tabby who made the corner of the veranda her favorite roost and submitted to such outrages with the patience of a poor servant-girl bearing the vicarious brunt of a family squabble. A similar display of spite often makes existence a burden to the cage-companions of a Hanuman ape, a chief saint of the zoölogical pantheon of Brahmanism. In Hindostan the undisputed prestige of that eupeptic demi-god secures him a constant surfeit of tidbits, and in Western menageries the lack of appreciation and cream-pies often provokes him to snub his secular fellow-captives with the vindictive arrogance of an exiled abbot.

In the semi-human apes the concupiscent curiosity of the genus often takes the form of abstract inquisitiveness—the root of all heresies. A young chimpanzee, that accompanied me on my last return trip from Antwerp, would examine the construction of a padlock with the interest of an amateur mechanic, and once passed a whole hour in the vain endeavor to solve the enigma of a baby-rattle—a perforated shell inclosing a number of metal pellets. After scrutinizing the marvel from all possible points of view, he made a cautious attempt to open the shell with his teeth, but the reprimand of a spectator at once made him relinquish that plan. He then deposited the shell on a rug, and, turning it over and over, frequently stopped to listen, as if comparing the results of his various experiments. My Cutch baboon, too, will examine a picture-book, page for page, and occasionally use his fingers to verify the impression of a striking illustration—an expedient which apparently fails to dispel the illusion of a looking-glass, for,

after the experience of a hundred *séances*, he still persists in making a grab at the empty air *behind* the frame, in the obstinate hope of corroborating the material existence of his *Doppelgänger*. After thoroughly familiarizing himself with the contents of my sitting-room, he has ceased to overhaul my shelves; but the introduction of any novel object at once re-excites his curiosity, and for similar reasons the wary four-handers of the South American tropics promptly emerge from their hiding-places at sight of a speckled dog—a zoölogical phenomenon too wondrous to be ignored from motives of discretion. An unfamiliar sound, the tinkling of a cow-bell in a new clearing, or the whirr of a buzz-saw, is equally sure to attract the attention of the four-handed aborigines. They will pursue the strolling bell-ringer for miles, and often stop to compare notes in a sort of solemn whisper.

But that scientific enthusiasm of our tree-climbing cousins is apt to be dampened by the first drop of night-dew. In daytime the restless vigilance of the tree-man enables him to hold his own against his wiliest foes; but after sunset the owl-eyes of the prowling *Felidæ* give them a fatal advantage, and the instinct of *night-fear* may thus deeply, and perhaps indelibly, have impressed itself upon the mental organism of our forefathers. A petted four-hander of the bolder species, the East Indian Rhesus, for instance, will contract a habit of pursuing his *penchant* of free inquiry to any length, even through the door of a shooting-gallery, which he will push wide open to ascertain the cause of the abnormal detonations; but after dark the same investigator will flee from the rustle of a dry leaf, and watch the shadow of a fluttering curtain with the rapt expectancy of a second adventist.

Inveterate habits persist. The progress of evolution has changed our spooks from hairy bugbears into soft-handed familiars, and may yet change them into kid-gloved exquisites; but, with or without claws, ghosts will probably continue to appear after sunset.

SKETCH OF EDWARD ATKINSON.

THE subject of the present sketch holds a prominent position among American writers who have made most valuable contributions to political and economic science. His essays, all in this or related departments, are characterized by far-reaching grasp of thought, boldness and absolute independence in discussion, and the clear and direct manner in which the principle he is seeking to develop is presented.

EDWARD ATKINSON was born in Brookline, Mass., February 10, 1827. Having fitted for college, it became expedient for him to go to work at an early age, and he served his time, after August

8, 1842, in a commission-house for the sale of domestic cotton goods. In 1848 he entered the service of manufacturing companies, and from that date until 1878 was engaged as treasurer or manager of factory corporations. In 1878 he became President of the Boston Manufacturers' Mutual Fire-Insurance Company, and has since devoted his time largely to the study of the prevention of fire in factories.

In one of his essays he says that he first began to think in the Free-Soil campaign of 1848; that he then despised statistics, and was under the profound conviction that every advocate of free trade had a cloven foot. He held to these opinions until about the beginning of the war. Being prevented from entering the service by home duties, he devoted himself to the study of the resources of the United States, and from the study of facts rather than of books, and from his long experience, he became an advocate of hard money, opposed to the Legal-Tender Act, and in 1866 he also became a convert to free trade, subject in its application to such consideration as might rightly be given to branches of industry whose course had been somewhat altered by the long continuance of the protective system.

Besides his studies in economic science, and above them, according to his own estimation, Mr. Atkinson is the inventor of a form of cooking apparatus by which the process of preparing food is greatly facilitated, while the quality of the product is certain to be improved. It comprises two ovens, one heated by a column of water, the other heated by a column of air, the heat being derived from common kerosene-oil lamps so arranged that the products of the combustion of the oil can not touch the food. Having baked twenty pounds of bread in one oven with one cent's worth of oil, and being able either to simmer in one vessel or to roast in the hot-air oven thirty pounds of meat at a cost of not exceeding two cents' worth of oil, he believes that he has accomplished economy in domestic cookery in a way which Count Rumford attempted but failed to make popular, but which might become the common practice of all, now that kerosene-oil yields a cheap source of heat. These inventions are not patented, but are purposely left open for public use.

By his connection with an association of New England mill-owners, for prevention of fires in their factories and for insurance, he has been instrumental in raising the profession of underwriter from a mere system of betting on the chances of loss by fire on property, as it may happen to be at any given time, to one in which science shall be applied at every point, both in the construction and occupation of buildings, and to the prevention of such losses, under the direction and instruction of capable officers of insurance companies, who will consider every loss by fire an

obnoxious incident for which some person, generally the owner or occupant, shall be held responsible.

From the fruits of his studies in economic science he has sustained, or perhaps first presented, the proposition that the burden of a tax upon any commodity can be truly measured only by its ratio to the margin of profits on a given manufacture rather than by its ratio to the total cost of the product into which the taxed material enters as a component. Hence a tax bearing a very small ratio to the gross value of the product, when imposed upon some apparently insignificant article which enters into a process of manufacture, may entirely forbid the establishment of that branch of industry in a country where otherwise it might have been successfully established. He therefore opposes duties on what are commonly but incorrectly called "raw materials," for the reason that such duties, when imposed upon crude or partly manufactured materials which are used in the various processes of domestic industry, not only cripple the manufacturers, but also injure the domestic producers, even of the same materials, by restricting their use.

He has, further, worked out and presented facts in proof of the theory that the wages or earnings of those who are commonly called "*the working-classes*" are a result of production, and can not be considered an antecedent to production which can be absolutely measured and determined or agreed upon for any considerable period before the work is undertaken, since all taxes, profits, and wages must, in the long run, be derived from the product itself. It follows, however, from this principle that, under free conditions, high wages in money, or in what money will buy, must in the end be the necessary correlative or consequence of a low cost of production. In other words, the price of labor does not measure the cost of labor, the cost of labor depending upon many other elements than the wages or earnings of those who take part in the conversion of the cruder products of the soil, the mine, or the forest, into the finished forms commonly known as manufactures.

He has also maintained the proposition that under free conditions of exchange the workman must of necessity, decade by decade, secure to his own use or enjoyment an increasing share of an increasing product, even though free exchange be limited in the United States to its own area—the exceptions to this rule being in countries where the free exchange of services is obstructed by the diversion of products in the form of taxes to the support of great standing armies, or to the payment of interest on huge national debts. In such instances, the benefits of improvement and invention being taken up by the tax-gatherer, it may follow that the workman is, decade by decade, becoming poorer and more in-

capable of sustaining himself in comfort and welfare. This conclusion—that labor receives a constantly increasing share of an increasing product, and that capital receives a diminishing share of an increasing product—which Mr. Atkinson has demonstrated, is one of the most encouraging facts that have been discovered in the progress of modern civilization. It tends to show, what we now know to be the fact, that there is a gradual equalization in the distribution of property, and that a larger number of persons in this age possess a competence than in any other period of the history of the race.

The proposition that the burden of a tax upon any commodity is measured by its ratio to the margin of profit rather than to the entire cost of the product, is vigorously presented in an article on "The Visible and Invisible in Protection," which was published in the "Atlantic Monthly" for February, 1872. Its truth is even more evident in the condition of our country to-day than it was at that time. Classifying commodities subject to taxation, as those which are of necessary use in processes of domestic production, and those which are of voluntary use on the part of the consumer, the paper lays down the principle that, "in accordance with the rule that it is fit to take, under the necessity of taxation, a small portion of the luxury or even the comforts which men seek as the end of their labor, rather than to impair their means of subsistence, taxes should not be imposed upon articles of the first class, but may be imposed upon those of the second class." The effect is then considered of the taxes then and now imposed upon articles of the first class in their relation to profits, and is gauged by comparison with an imaginary tax upon an article in universal use on which no tax would be tolerated, if it were imposed. Such an article is milk, with its products, butter and cheese. Suppose their price were increased by the imposition of a tax of fifty per cent. "There would surely be controversy, bitter discussion, and perhaps violent resistance, should such a tax be imposed; and yet the general cost of subsistence would be no more increased, while the power of enlarged production would be far less restricted and hampered, by a tax of fifty per cent upon dairy products, than they are now by the tariff taxes imposed on foreign imports of crude or partially manufactured materials. Nor would the burden be distributed more widely. The use of dairy products is no more universal or necessary than the use of the articles of foreign import named in our list" (including a number of articles of the first class); "and there is almost as much luxurious consumption of dairy products as there is of foreign imports. It may be asserted, without fear of contradiction, that all these articles imported from other countries are as much the product of American labor as the dairy product, or as if they

had been raised upon American soil by the hands of native-born men and women, since every one of them has been or must be paid for by an exchange of some domestic product for it, whether it be cotton, oil, gold, cheese, or wooden clocks; and the only reason why this exchange is ever made is that we have too much of the things made upon our own soil, and too little or none at all of those things of foreign origin for which we make the exchange. Production is but a *leading forth;* it is but movement. We move the cotton-seed to the soil, the cotton to the Northern mill, the cloth to the seaboard; then, by the steamship, we move it to where it is more needed than by ourselves; we move back the tea, and the tea is but the final product of the labor of the freedman, the operative, and the sailor, each of whom is or may be our countryman, and each of whom is counted as a representative of home industry. . . .

"We once established the manufacture of furniture, so that our mechanics, working at from $2.50 to $3 per day, yet supplied many foreign customers; but we have taxed the wood, the varnish, the oil, the paint, the tools, the food, and the fuel of these men forty per cent on all those portions which are of foreign origin, and thus they have lost their customers. Privation of imports is prohibition of exports. Protection to the mechanic is to be found only in the repeal of bad taxes."

The far-reaching nature of the evil of wrongful taxation is illustrated in the case of the taxation of tin plates, for which revenue the Government has no use whatever, but by the operation of which "we leave England and France to supply the world with canned meats and fruits, while we only put up enough for our own use." This result is brought about by the tax adding to the cost of the domestic product into which the tin enters as a constituent element; "and if this increase amounts to only two or three per cent of the value of the finished product, it amounts, as we have proved, to a tax on the income of capital of from two or three up to ten or twenty per cent. Hence, foreign capital takes the business, and home labor ceases to be employed; diversity of employment is prevented; wages are lowered, and the cost of subsistence increased; and all this is done in the name of protection to labor!"

The visible in protection—what one sees, "is that we prosper in spite of all the privations inflicted under due process of law; such are the boundless resources with which the Almighty has endowed this land." The invisible, what one does not see, "is the far greater prosperity which we might have, except for the ignorance of those who make these unjust laws, and in the name of protection inflict privation. What one does not see is the progress in the arts of peace and good-will with all nations which

might ensue if we did but realize that the ships that pass between this land and that are like the shuttle of a loom, weaving the web of concord among the nations, and that commerce is the most potent agent of civilization."

Mr. Atkinson is what is called a self-educated man, but he accepts the comment made by Dr. Francis Lieber on this phrase, that one might as rightly speak of a self-laid egg. What both gentlemen mean by this *dictum* doubtless is that men are inevitably the creatures of the conditions among which they are placed, over which they have no control. But, as it is usually applied, the expression "a self-made man" means no more than that his character and faculties have been developed independently of the artificial aid of schools and book-lore, by hard contact with the world and the experiences of active life; and Mr. Atkinson would hardly deny that he is a man of that kind. What he is, in character and modes of thought, is in the main the product of a life spent in the factory and counting-house, combined with habits of close, independent observation. A clew as to the turn which his seeking takes when knowledge is to be acquired, may be gained from the opening sentences of his paper on "Kentucky Farms," in "Harper's Magazine" for June, 1881: "Whenever a business man gets away from his affairs, and journeys into a far country for even a short time, he may see many things that he would entirely overlook if, with his mind filled with the every-day cares of life, he passed through the very same sections in the usual unobservant way. A pity it is that our commercial travelers could not become trained observers, ready and acute as they are in all that pertains to their work, often witty and full of good stories. If they could learn to spend the many hours which they are obliged to pass wearily in country taverns that are none of the best, and are often of the worst, in reporting what they might observe, what a resource against weariness it would be for them, and what a benefit to all who wish to know what the resources of this country really are, and how they could be developed! The business man who can write at all writes best for other business men." To this habit of sharply observing for himself, Mr. Atkinson adds, as he goes on to relate, what he calls a patent method of his own. He goes to persons—as for instance, in this case the State geologist, in studying the resources of Kentucky—who have special knowledge of the subject in hand, and becomes, for the time being, their student. By such means he has accumulated a vast fund of information about the resources of the United States, and the condition of the different parts of the country, which, having made himself familiar with the subject in hand, he can use with telling effect whenever he has a condition to account for, or a lesson to draw indicating a line of policy. His journey to Kentucky was

made to obtain information about the homespun fabrics that are made and worn by the people of the mountain-regions of that and the adjoining States. In a discussion concerning the conditions of transporting flour from Minneapolis to Europe, he acknowledges indebtedness to twenty-six distinct sources whence he obtained information, including railroad presidents, manufacturers, editors of special journals, Government officers, and managers of land-mortgage companies. The purpose of the discussion just named was to prove that it was possible to supply the European markets with breadstuffs at a very low cost, and at the same time secure high earnings to farm-laborers, coupled with reasonable profits to the farmers, millers, and transportation companies. Having shown that the wages of one day's work of a good mechanic on the Eastern seaboard of the United States will suffice to move his year's supply of grain and meat one thousand miles from the Western prairie, while the skilled workman of Great Britain may also move his year's supply of grain and meat four or five thousand miles at a cost of two days' labor, possibly three, he adds: "Have not the scientists who have eliminated time and distance made the whole world one great neighborhood in which each man may serve his neighbor? But the masters of physical science have only removed natural obstructions. There is work now for the masters of political science. It now remains for Legislatures to remove the artificial obstructions created by their predecessors in order that each nation may serve the other. When that is done, the interdependence of the men of all countries and of all climes will be established, and the foundation of peace, order, industry, good-will, and plenty among all nations will be firmly laid."

Such is the destiny to which Mr. Atkinson, despising the petty devices and make-shifts of politics, and looking only to what will contribute most directly to the ultimate result, would lead us.

Mr. Atkinson is a member of the American Academy of Arts and Sciences, of the British Association, Fellow of the American Association for the Advancement of Science, of the American Statistical Association, of the Political Economy Club, of the International Statistical Institute, of the Cobden Club, and several other bodies of like kind. He has never held any public office except when commissioned by the President in 1887 to report upon the status of bimetallism in Europe. He has always been an independent in politics.

The various papers which have been written by Mr. Atkinson are constantly referred to in economic discussions by persons who differ with each other and who do not accept his conclusions, his analyses of the facts of the economic life of the nation being accepted even by those who do not agree with his theories.

His papers on the industrial development of this country, especially during the last twenty-five years, are cited by the advocates of both policies in the present tariff controversy. Their ability and fairness of statement are fully admitted. Mr. Atkinson himself believes that the tariff question is one of the minor factors in the industrial history of this country; that its influence in promoting certain branches of industry has been much exaggerated on the one side, and that its burden upon consumers has been as much exaggerated upon the other. He rejects alike the theory of the extreme advocate of protection, that diversity of occupation has been promoted by means of the protective system; and, on the other hand, he rejects the theory of the extreme free-trader that an enormous bounty has been paid to or gained by special industries, merely because a duty has been imposed upon a foreign import of like kind. He holds that while manufactures would be established in greater variety, and would attain ultimately much greater prosperity, if free exchange could be attained by a cautious and systematic reform, on the other hand, the market for the excess of the crude products of our soil, as well as for our manufactures, might be vastly extended by such reform—to the end that the United States would attain a commanding position in the commerce of the world, even to the extent of possibly compelling European nations to disarm. Keeping in view the proposition that profits, wages, and taxes are alike derived from the joint product of labor and capital, he presents the simple formula that "a nation free from debt, subjected to the lowest rate of taxation of any nation in the world, and without the need of withdrawing from productive labor an enormous number of men to be enlisted in a standing army or navy, and finally endowed with greater natural resources than any other country in proportion to the population, must be able to compass a larger product at less cost than can be attained in any other of the so-called manufacturing countries." He therefore advocates a gradual but sure reform of the abuses which exist in the present acts for collecting the national revenue, to be brought about with due regard to the present condition which many branches of manufacture have reached during the long period in which a high tariff has been in force."

Mr. Atkinson's essays, nearly all upon subjects of political economy, have been published at various times since 1861 in independent pamphlets, the reports of economical associations, and periodicals of general circulation, such as the "Atlantic Monthly," "Scribner's Magazine," "The Century," "Harper's Magazine," and the "North American" and "International Reviews." The full list numbers more than forty titles, including the following: "Cheap Cotton by Free Labor," 1861; "Is Cotton our King?" 1862; "The

Future Supply of Cotton," 1864; "The Collection of Revenue," 1866; "Free Trade and Revenue Reform," 1871; "The Visible and Invisible in Protection," 1872; "An Easy Lesson in Money and Banking," 1874; "Argument for the Conditional Reform of the Legal-Tender Act," 1874; "Commercial Development in the First Century of the Republic," 1876; "Industrial Reconstruction," 1878; "Our National Domain" (chart), 1879; "American View of American Competition" (London), 1879; "Labor and Capital Allies, not Enemies," 1880; "The Fire-Engineer, the Architect, and the Underwriter," 1880; "The Railroads of the United States," 1880; "The Unlearned Professions," 1880; "Address on Banking," 1880; "A Reply to Prof. Bonamy Price," 1880; "Cotton Manufactures of the United States," 1880; "Addresses at Atlanta, Ga., at the International Cotton Exposition," 1880, 1881; "What is a Bank?" 1881; "Elementary Instruction in the Mechanic Arts," 1881; "Address at the Annual Banquet of the Massachusetts Charitable Association," 1881; "What makes the Rate of Interest?" 1881; Address on the Right Method of preventing Fires in Mills," 1881; "The Solid South," 1881; "The Railway and the Farmer," 1881; "Kentucky Farms," 1881; "The Influence of Boston Capital upon Manufactures," 1882; "Significant Aspects of the Atlanta Exposition," 1882; "The Rapid Spread of Communism," 1882; "Address at the Opening of the Manufacturers' and Mechanics' Institute Fair," 1882; "Inefficiency of Economic Legislation," 1882; "What makes the Rate of Wages?" 1884; "Address to the Chiefs of the Bureau of Labor Statistics," 1885; "The Distribution of Products," 1885; "On the Application of Science to the Production and Consumption of Food," 1885; "Prevention of "Loss by Fire," 1885; "The Hours of Labor," 1885; "Address on the Silver Question," 1886; a series of monographs (in "Bradstreet's") on economic questions; a series of articles (in "The Century") on "Food and Wages"; "The Margin of Profits," 1887; "Report on Bimetallism in Europe," 1888; a series of articles in "The Forum," 1888. Of these papers, the address at Atlanta, in 1880, was characterized by Judge E. R. Hoar as marking an "era in the history of the country"; and the book on the "Distribution of Products" was pronounced by Sir Louis Mallet "epoch-making."

It has been advanced as a weak point in the theory that man has received his qualities by inheritance from the other races, that when men manifest extraordinary qualities they are such as are entirely different from those possessed by any other creature, and peculiar. Human prodigies excel, not in the development of animal traits and instincts, but as wonderful calculators, great moral geniuses, or phenomenal musicians. The most wonderful instincts of the lower creatures appear to be extinguished by the advance of reason, instead of being stimulated by it; and men who transcend humanity do so not in the respects in which they have inherited most, but in those in which they have inherited least.

CORRESPONDENCE.

DOCTORS AND THE OPIUM-HABIT.

Editor Popular Science Monthly:

IN the September number of "The Popular Science Monthly," Mr. Virgil G. Eaton makes the following statement in his article on "How the Opium-Habit is acquired": "The parties who are responsible for the increase of the habit are the physicians who give the prescriptions. . . . Opium effects immediate relief, and the doctors, knowing this, and wishing to stand well with their patients, prescribe it more and more. Their design is to effect a cure. The result is to convert their patients into opium-slaves. The doctors are to blame for so large a consumption of opium, and they are the men who need reforming" (p. 666). While there may be exceptional cases where physicians are responsible for a patient acquiring the opium-habit, this charge against the entire medical profession is unjust and misleading. No class of men is better acquainted with the dangers due to a prolonged use of opiates than the medical practitioners, but it does not follow that a knowledge of the fact should lead any one of them to abandon the use of this valuable anodyne in suitable cases. No physician will question Mr. Eaton's statement that opiates are prescribed very frequently. If Mr. Eaton had taken the trouble to inquire from physicians why this is so, he would probably have ascertained that a large number of patients suffer considerably during their sickness, and that, to alleviate these sufferings, and give the patients the best chances for recovering their health, opiates are often prescribed, and not merely because the physician wants to "stand well with his patient," or even to "effect a *cure*." Surely, no honest practitioner would be brutal enough to withhold an anodyne to relieve the intense pain due to a "stone in the gall-duct" (and if it were in Mr. Eaton's personal gall-duct), provided the anodyne caused no other serious injury. In this case the anodyne is not given to "effect a cure," but to permit the passage of the stone through the duct with less pain to the proprietor of the duct than were possible without the drug.

While putting the responsibility for the opium-habit on the physicians, Mr. Eaton says (p. 665), "From a conversation with a druggist, I learned that the proprietary or 'patent' medicines which have the largest sales were those containing opiates." While Mr. Eaton's article proves his knowledge of the practice of medicine to be very limited, he can hardly be ignorant of the fact that the members of the medical profession have been and are to this day warning their patients and the public against the use of all nostrums. This is done by physicians, not for selfish purposes, as Mr. Eaton probably thinks, but because they have some thought for the health and well-being of their patients.

Immediately after telling us that the doctors are the men who need reforming, Mr. Eaton gives us two means for preventing the opium-habit. Here we find that he does not mention the method of reformation, but recommends that the renewal of prescribed medicines containing opiates, without the consent of the physician, be prohibited. Now this is a very good recommendation, but, as "there is nothing new under the sun," so this suggestion is not original. A perusal of medical literature would demonstrate that the medical profession, as individuals, and through their associations, have for years past protested and advised against renewing prescribed medicines without the physician's consent. They would not, however, have it limited to opiates, but have it apply to all medicines, for very good and not solely selfish reasons. After such good advice from Mr. Eaton, it is a great disappointment to find in the second and last suggestion that again no method of reforming the doctors is given, but here he mentions the very good but not always practical preventive for the opium-habit is not to get sick. True, Mr. Eaton does not put it in these words, but it is practically the same as to say: "Avoid sickness by living according to the laws of health. If you are not sick, you will not require medicine; and if you don't take medicine, you will not become a victim of the opium-habit."

After so clearly showing that "patent" medicines, and the druggists, who so willingly refill prescriptions, are to a very great degree responsible for the alarming increase of the opium-habit, Mr. Eaton's charges against the physicians are entirely out of place.

A. F. STIFEL.

WHEELING, W. VA., *August*, 29, 1888.

OUR ASTRONOMY CLASS.

Editor Popular Science Monthly:

IN Chapter IX of "Prince Otto," by Robert Louis Stevenson, better known to fame as the author of "Dr. Jekyll and Mr. Hyde," the hero goes to an appointment with the countess, "as the bell beats *two*" in the morning. At this hour, we are told, "a shaving of *new moon* had lately arisen; but was still too small and too low down in heaven to contend with the immense host of lesser luminaries, and the rough face of the earth was drenched with starlight."

The object of this communication is to nominate Mr. Stevenson for membership in that "infant class in astronomy" to which you have already assigned H. Rider Haggard, Anna Bowman Dodd, Andrew Lang, Edward King, and Tolstoi. J. BOULWARE KIDD.

RICHMOND, VA., *August*, 19, 1888.

CALIFORNIAN PERFORATED STONES.

Editor Popular Science Monthly:

I THINK your correspondent is in error concerning the uses of the perforated stones of California.* I never heard of any one of those uses before, and all of them seem improbable.

1. I have seen the squaws digging roots, and never knew of their carrying a five-pound stone around, when their own body furnishes one hundred and fifty pounds, as a "digging weight." In their line of business they are no fools.

2. Each arrow and spear of the Indians represents hours of patient labor, and any one acquainted with them knows how averse they are to expending them upon any mark other than game, much less upon rocks. One of these stones, now in my possession, has the eye-hole much out of the center, and who can determine the line that hole would describe when the stone is rolled along on the ground? Further, the Diggers were and are averse to any games that do not allow them to sit lovingly and lazily upon the bosom of Mother Earth.

3. Pipes and pestles are the only "cylindrical objects" I know of among the Indians, and none of these are small enough to go through the eye-hole. It shows no evidence of having been used as a die; and those objects show no evidence of having been made by a die.

Now, as to their real uses. The specimen of which I send you an outline is a fair sample of most of them. Weight, four and a half pounds. The eye-hole is countersunk on both sides, coming to an edge in the center, but more sloping on the right, fitting the thumb of the right hand, whichever side was grasped, as both sides are very nearly alike.

1. Indians tell me that they were used for pounding acorns and other nuts fine enough to be afterward ground on the *metate* for making bread.

2. They were used for heating water and cooking in baskets; a stick run through the eye-hole of the hot stone prevents it from sinking to the bottom and burning a hole through the basket. I once saw the Indians cooking in a basket, but not with these stones. The basket stands near the fire, and with half a dozen hot stones constantly being changed they will have the water boiling much quicker than it can be done on a stove. The above information I get from the Indians, and it accords with the probabilities and other evidences.

I inclose an outline of another stone which for a long time puzzled me. It is a flat cog-wheel one and a half inch thick. Four of them were plowed up in an Indian camp, the only ones I ever saw. An old Indian the other day instantly placed the palm of his hand flatly over the disk, and, with his fingers among the cogs, made motions as with a hammer, and said it was used for cracking *piñones*. The *piñone* is the nut of a certain pine-tree, of which the Indians used to gather large quantities for winter use. Yours truly,

FRANKLIN COGSWELL.

POMONA, LOS ANGELES CO., CAL., *August*, 14, 1888.

* "Popular Science Monthly" for August, p. 569.

CAN ANIMALS COUNT THE DAYS?

Editor Popular Science Monthly:

IN looking over back numbers of "The Popular Science Monthly," an article in the issue for June, 1886, entitled "What may Animals be taught?" attracted attention. In the early part of the paper an instance of animal intelligence is quoted, and remarks thereon made by the author which, to the thinking of many, rob our "inferior brethren" of credit justly their due, and of faculties evidently their own. The instance is as follows: "M. Dubuc speaks of a pointer which had learned, after a few years, that its master went hunting every Sunday, and therefore that the animal had learned to count up to seven." The author of the article says: "This conclusion is not legitimate; it may even be said to be wrong. The dog distinguished Sunday by some features peculiar to it, by the movements about the house, the behavior and Sunday dress of the servants, the dress of the master, or any one or more of a number of things that make Sunday different from other days of the week; but we may say without contradiction that it did not count seven."

Nevertheless, facts do, to all appearance, contradict that dogmatic assertion. For myself, I can not see why the conclusion is denied that animals, as they come to apprehend the advent of Sunday, have some way of keeping count of the seven days of the week. The following fact bears directly upon that point: Something like half a century ago, the writer had the care and milking of five cows during one summer. They grazed in a pasture-lot many rods from the dwelling. It was the custom to give the animals salt every Sunday morning. They enjoyed the treat, and it was evident that they began to expect it. After a length of time—I can not say how long—a curious behavior of the cattle became conspicuous, for every Sunday morning they were found standing at the bars, the point nearest the house, with every ap-

pearance of mute expectation. At every other morning, as well as at evening, they had to be sought and brought to the bars for milking. Sometimes I would forget to take the salt with me at the stated time, when, instead of moving off to feed after my task was done, as they usually did, they remained about the spot an hour or so, as if waiting for their weekly rations of salt.

Here, then, is the problem: Every Sunday morning these cows came of their own option to the place of milking, and where on that day they generally got salt, and not on other mornings. How could they do that, except through some faculty of estimating the seven days of the week? If "the dog distinguished Sunday by some features that were peculiar to it," we can not say the same of the cows in question. They were isolated from the outer world, away from any thoroughfare, and saw no one but myself from one week to another and from one month to another. So far as we can judge, one day was like all days excepting Sunday, which they might have called *salt-day*, had they possessed the faculty of speech. How did they note that cycle of time, to be there on that morning and not on any other morning?

A. S. HUDSON, M. D.

STOCKTON, CAL., *September* 1, 1888.

EDITOR'S TABLE.

THE MORALITY OF THE FUTURE.

ONE of the most interesting papers read at the recent meeting of the American Association for the Advancement of Science was one upon "Altruism considered economically," by the Vice-President of the Section of Economic Sciences, Mr. Charles W. Smiley. The drift of Mr. Smiley's address, which may be read in our present number, was to the effect that the impulse to do good to others at the cost of sacrifice to one's self was one that required careful watching and discipline, as otherwise it would be very likely to prove more harmful than beneficial. The more we study the operation of the fundamental laws of nature, the more clearly we see how essential they are to all healthy living; and how little upon the whole is gained, and how much is lost, in the effort to transcend them in the name of higher principles. Thus, self-preservation is the first law of all animated life; but some have thought it worthy only of the brute creation, and have preached in its stead the law of self-sacrifice. Doubtless, as Mr. Smiley admits, there have been times in the history of the world when there was pressing need for the preaching of self-sacrifice as a corrective to the selfish and unscrupulous pursuit of personal ends; but the time has now come in our modern civilized communities when it should be seen that the highest service any man can render to the community is not to devote all his goods to feed the poor, or perform any other signal act of self-denial, but to practice justice and labor to strengthen the characters of those around him. Self-sacrifice as a principle is wanting in logic, seeing that it implies the gain of one through the loss of another. We have had in the past, and still have, numerous institutions that have sprung from the idea of self-sacrifice; and, with a large portion of the community, it is a fixed idea that only acts involving self-sacrifice can have any merit. But experience is showing more and more that those who are supposed to stand in need of all this voluntary benevolence derive but little real advantage from it; that, on the contrary, it further weakens their already defective characters, and tends to make their condition one of chronic and constitutional dependence on the assistance of others.

How is it, we may ask, that, in spite of all that is done for the poor in the way of charity, the demand for charity is annually greater and more pressing? The object of giving help ought to be to raise the recipient above the need of help; but this result is manifestly not being accomplished. For one charitable fund that existed a generation ago there exist at least five to-day; and almost every week something new is started, look-

ing to the removal, by force of charity, of this or that form of social misery. Every now and then some agent of this charitable work makes a confession as to its very general inutility; indeed, parodoxical as it may seem, none know so well how little charity in any form can do for the poor as those who are foremost in charitable efforts, or most immediately concerned with the actual distribution of help. It is undeniable that, just in proportion as the liberality of the charitably disposed increases, the demands upon it increase, and that, conversely, with the cessation of alms-giving, the need for it seems to vanish. There are facts to illustrate both points. We have seen it stated lately in the Boston papers that the abounding charities of that city have drawn to it people who consider themselves objects of charity from all the surrounding country; and, if so, we can judge what the effect has been in the city itself in promoting mendicancy. Only last Christmas one of the Boston papers was calling attention, with evident satisfaction, to the vast increase within a few years in the number of Christmas turkeys distributed gratis to the poor; as if such an evidence of the progressive pauperization of the community was not more to be deplored than the increasing liberality of a few to be rejoiced over. On the other hand, Mr. Smiley, in the address to which we have referred, states that the discontinuance of out-door relief in Brooklyn, Cleveland, and Cincinnati has been followed by an almost complete disappearance of any visible necessity for the administration of such relief.

The morality of the future, we may therefore safely say, will be based less upon self-sacrifice than upon individual culture and self-restraint, and will exhibit more and more the beneficent workings of what Mr. Spencer calls the law of equal liberty. This, indeed, is the only moral *régime* befitting the industrial and democratic stage of society. In ages of great social inequality, when the great tyrannize and the weak cringe in submission, there is urgent need for the intervention of generous spirits to do and to dare what the victims of oppression can neither do nor dare for themselves; but with the removal of all unjust privileges the need for such action largely disappears. If unduly prolonged its effect is to make the weak weaker, the helpless more helpless. The time, we hold, has come now when, broadly speaking, the best thing any man can do is to hold himself erect, to practice a high-minded justice in his relations with his fellow-men, and to eschew all modes of action calculated to encourage others to expect that they may reap where they have not sown. Speaking broadly again, our present modes of charity tend to no good. A truer charity by far would be to vigorously protect society from the vicious and criminal class; and, in regard to the limited class of non-vicious paupers, to let them understand that what they earn they shall eat and no more. This is the course we shall follow if we want a perfected society. If, on the other hand, we are prepared to make all sacrifices, alike of principle and of expediency, for the sake of emotional gratification, we shall proceed in the practice of an ever-extending sentimental charity; and the poor and degraded we shall ever have with us, and yet more abundantly.

"*THE VALUE OF THE NEXT-TO-NOTHING.*"

Sir Frederick Bramwell, President of the British Association, chose as the subject of his inaugural address the singular reading, "The Value of the Next-to-Nothing; and the Civil Engineer, and the Value to Science of his Works." His purpose was to show how the civil engineer, applying results already worked out by science, enlarging resources and facilities and increasing economy, had aided and stimulated science to new researches to be utilized

again in his own inventions, which were in turn to give a further impulse to scientific work. A very large proportion of the engineer's success was due to his regarding infinitesimals; and in respect to this point it was appropriate for the speaker to show how greatly infinitesimals or "next-to-nothings" determine the strength, the fitness, and the durability of works and materials. Take the case of steel, which in times that are not very old was dealt with and tested in a "rule-of-thumb" fashion. It was known to be a compound of iron and carbon—

"but the importance of exactness in the percentage was but little understood, nor was it at all understood how the presence of comparatively small quantities of foreign matter might necessitate the variation of the proportions of carbon. The consequence was, that anomalous results every now and then arose to confound the person who had used the steel, and, falsifying the proverb 'true as steel,' steel became an object of distrust. Is it too much to say that Bessemer's great invention of steel made by the 'converter,' and that Siemens's invention of the open-hearth process, reacted on pure science, and set scientific men to investigate the laws which regulate the union of metals and of metalloids, and that the labors of these scientific men have improved the manufacture, so that steel is now thoroughly and entirely trusted? By its aid engineering works are accomplished which, without that aid, would have been simply impossible. The Forth Bridge, the big gun, the compound armor of the ironclad with its steel face—all equally depend upon the 'truth' of steel as much as does the barely visible hair-spring of the chronometer, which enables the longitude of the ship in which it is carried to be ascertained. Now, what makes the difference between trustworthy and untrustworthy steel for each particular purpose? Something which, until our better sense comes to our aid, we are inclined to look upon as ridiculously insignificant—a 'next-to-nothing.' Setting extraneous ingredients aside, and considering only the union of iron and carbon, the question whether there shall be added or deducted one tenth of one per cent of carbon is a matter of great importance in the resulting quality of the steel. This is a striking practical instance of how apparently insignificant things may be of the highest importance. The variation of this fraction of a percentage may render your boiler-steel untrustworthy, may make the difference between safety in a gun and danger in a gun, and may render your armor-piercing projectile unable to pierce even the thinnest wrought-iron armor."

So the effects upon steel of adding manganese—whether it shall improve or deteriorate the metal—are matters of rather delicate calculation—

"and the effects of the addition of even the very smallest percentages of aluminum upon the steel with which it may be alloyed are very striking and very peculiar, giving to the steel alloy thus produced a very much greater hardness, and enabling it to take a much brighter and more silver-like polish. Further, the one twentieth part of one per cent of aluminum, when added to molten wrought-iron, will reduce the fusing-point of the whole mass some five hundred degrees, and will render it extremely fluid."

The engineer engaged in electrical matters is also often compelled to realize the importance of the "next-to-nothing," as in the case of the influence which an extremely minute percentage of impurity has on the electrical conductivity of copper wire. This conductivity is, in some cases, reduced as much as fifty per cent, in consequence of the admixture of that which, under other circumstances, would be looked upon as insignificant.

The internal strain which a great gun may suffer in the process of oil-hardening, by the operation of which it may be self-ruptured months afterward, is gauged in the most minute fractions of an inch. The various degrees to which a tool is tempered according to the uses to which it is to be adapted, all depend upon the "next-to-nothing" differences in the temperature to which the metal is heated. Then—

"consider the bicycles and tricycles of the present day — machines which afford the means of healthful exercise to thousands, and which will probably, in a very short time, prove of the very greatest possible use for military purposes. The perfection to which these machines have been brought is almost entirely due to strict attention to detail; in

the selection of the material of which the machines are made; in the application of pure science (in its strictest sense) to the form and to the proportioning of the parts, and also in the arrangement of these various parts in relation the one to the other. The result is, that the greatest possible strength is afforded with only the least possible weight, and that friction in working has been reduced to a *minimum*."

Finally, the hardly appreciable difference in the density of the air on the upper side and the under side, of a shot issuing from a gun is sufficient to deflect the missile toward either side, according to the "hand" of the rifling, to such an extent that it has to be allowed for in the sighting and rifling of guns designed to be fired at long range. So, in fixing long-range guns, pointing north and south, the difference in the velocity of the earth's rotation at the two ends of the range has to be taken into consideration.

Sir Frederick's address having begun by showing how applications of science and discoveries act and react upon and further one another, and having illustrated the importance of minute details in this mutual helping, closed with a demonstration that engineering has a poetical side.

The building of such a work as the Eddystone Lighthouse, the throwing of a long and lofty span across a navigable river or strait, or the tunneling under a body of water—like the English Channel, for instance—with the closer bringing together of peoples that would result from it, or the execution of a sanitary work that will reduce disease one half—a thing that is not unknown—afford abundant scope for emotion and flight of the imagination. Whether it be these, or the supply of pure water to every dwelling—

"or the distribution of light or of motive power; or whether it be in the production of the mighty ocean-steamer, or in the spanning of valleys, the piercing of mountains and affording the firm, secure road for the express-train; or whether it be the encircling the world with telegraphs—the work of the civil engineer is not of the earth earthy, is not mechanical to the exclusion of science, is not unintellectual; but is of a most beneficent nature, is consistent with true poetical feeling, and is worthy of the highest order of intellect."

LITERARY NOTICES.

ANIMAL MEMOIRS. Part I.—MAMMALS. By SAMUEL LOCKWOOD. New York and Chicago: Ivison, Blakeman & Co. Pp. 317.

THIS book is the first of a projected series of "Readings in Natural History," in which the author purposes to present mainly individual portraits, or animal biographies, in the fourfold setting of their morphology, physiology, chorology (or geographical occupancy), and origin, "but so far as possible without technicality of treatment, and with as little formal limning as is compatible with clear and truthful outlines." Preference is given, where possible, to such creatures as the author has known with the intimacy that attaches to pets. In accounting for the origin of the book, Prof. Lockwood describes how his own interest in natural history began. It arose from his picking up, while he was a very small boy, a torpid snake which had been chilled in a severe storm. Having taken it home, he was examining its diamond-pointed scales, when it revived under the influence of the warmth, and was at once dispatched by an older brother. "I felt very badly," he says, "to have it taken from me. But a little picture of its ornamentation held a place for a long time in my memory. The pattern was a mosaic of pretty geometric figures. From that time on my taste grew. I had that day got a nibble in the lane which led to the rich and open field of nature. What an appetizer it proved to be! I hungered for more. My first book was Goldsmith's 'Animated Nature,' which was read and reread with avidity. I took in everything, even the wild statement that Indians had passed safely over the Falls of Niagara in their canoes." The key to the author's mood is given in the sentence, "With the imagination and judgment in healthful union, let one enter into the mind of the animal—that is, put himself in its place—and it will be surprising how much of one's self can be seen in that lowly thing." Prudence and foresight, forecasting of the weather, mag-

nanimity, and sympathy in distress, or something that works very much like them, may be seen in different degrees of development in certain animals. A story of a doctor at Long Branch, who had a hen that took a kitten as one of her chickens, is offset by one of a cat in the old country, which, being given a chick partly emerged from the shell, "began at once removing the shell in the most tender way; and this done, she put the callow thing by the side of her kitten and nestled them together"; and was grieved when the attempt was made to take the chick from her. Intelligence and a kind of scientific scrutiny were shown by the turkey that swallowed grasshoppers, which it knew all about, "without stopping to think," but when given a large black beetle, "very deliberately put down his head and inspected the insect; then stepped back quite cautiously, then approached, and, stooping as before, again gazed at it intently. Not yet satisfied, he now walked around it with a curiously cautious strut, keeping his eyes all this time upon the dubious morsel. Now his movement is quicker, and, becoming assured, he seizes the insect and it is swallowed at once." The opening chapters exhibit in various ways what is styled "the exuberance or overflow of 'animal mind,'" in the hope of awakening in the reader the faculty of insight, "so that he may be to the animal what it so often is to him—'a discerner of spirit.' For, is it not too apparent that in this respect the 'dumb beasts which perish' are often our superiors? In divining the mind of his master the dog rarely errs; and how subtle his discrimination of 'the stranger at the gate'! These mental manifestations indicate the one maker of animals and men. . . . No pessimist ever made much in the study of the life-histories of animals. The student of such had better be optimist out and out." With these animals "are all kinds of mental manifestation—the gleesome and the serious, the pathetic and the sympathetic, the jocose and the morose." The first story illustrating "animal humor" is of a monkey in a basket-shop, which was the pet of the men and boys, and afforded them all manner of sport until they became tired of it and began to play malicious tricks upon it, when "it broke down, as if it had concluded to drop all sport forever. Not at all vicious, still gentle, but joyless, it became chronically sad"—but recognized a sympathetic voice when "the minister" called upon it, and reposed in him all the confidence and affection it had lost toward other men. Another monkey, which was kept in a cage, was suspicious and even vicious toward strangers, but became friends at sight with this same "minister," greatly to the surprise of its owner—"taking his measure at a glance." Another trait was exhibited by Frank Buckland's monkeys, which would care nothing for a carrot when given to them, but would eagerly avail themselves of an opportunity to steal it. We are not willing to say that this is a human trait, though some men seem ready to illustrate it. The stories of dogs afford displays of intelligence which must appear wonderful and almost incredible to all except those who are well acquainted with dogs, to whom they will have an air that is less novel. They show most remarkable perceptions of what is going on, of what the family and persons around wish, of what is intended to be done, and apparent understanding of language. These stories—of "animal humor"—are largely of animals within the author's own acquaintance. Those that follow—of sledge-dog antics (arctic), the onithorhynchus and its eggs, the kangaroos, coons, the coati mundi (concerning which Prof. Lockwood has contributed an article to the "Monthly"), the kinkajou, rabbits, and mice—are drawn largely from the observations of other writers. In the cases of the stranger animals the differences in their structure from that of the ordinarily mammalian type are duly explained, the technical terms being translated into intelligible English; and the final chapter is on "Classifying Animals."

NUMBERS SYMBOLIZED: AN ELEMENTARY ALGEBRA. By DAVID M. SENSENIG. New York, Boston, and Chicago. D. Appleton & Co. Pp. 315. Price, $1.26.

THIS volume is introductory to a more extensive and philosophical treatise with which the author designs to follow it. In scope it includes all subjects essential to a study of higher arithmetic, elementary geometry, and the elements of physics. All topics are treated in an elementary manner, with broad generalizations and discussions of general problems purposely excluded. In the earlier

lessons, fundamental ideas and principles are developed inductively, and then formulated into simple and concise statements; each definition, for example, is preceded by a problem that asks for it, making it thus something suggested by what has gone before, rather than an arbitrary statement, the meaning of which is to be found out by subsequent application. Further on, definitions appear at the beginning of subjects, and principles are deduced from the solutions of characteristic examples. And, still later, propositions are first enunciated and then logically proved. Thus the pupil is led by easy transition from the more elementary forms of reasoning to pure mathematical demonstration. Examples have been carefully selected both to be worked at sight and for written work, while long and pointless examples have been generally avoided. Factoring is treated with considerable fullness.

ESSAYS ON GOD AND MAN; OR, A PHILOSOPHICAL INQUIRY INTO THE PRINCIPLES OF RELIGION. By the Rev. HENRY TRURO BRAY, Boonville, Mo. St. Louis: Nixon-Jones Printing Company. Pp. 270. Price, $2.

THE author, who is an Episcopal clergyman, assumes that "men are everywhere drifting away from the old beliefs"; that the intellect of the world has "lost all faith in the Church of the past"; and declares that in his own experience he hardly ever finds a man who believes unqualifiedly the doctrines of the pulpit. Yet he has faith in the reality and permanence of religion, whose essence has been overlaid by glosses and superstition. In this book he hopes "in a measure to lead his readers to discriminate between the evanescent and permanent, between the temporal and the eternal; and to know that while they may doubt and reject the evanescent, the local, or the temporal, they should not and may not reject the permanent, the universal, or the eternal." He lays down as embodying the faith of the scientific world the propositions that "there is an infinite intelligence whom we call God; man is by nature a religious being; every religion has in it a nucleus of truth; no religion is exclusively true, or founded upon an exclusively divine revelation." And he attempts to show that religion is useful and natural; that its essentials are one; that God's revelation is universal and continuous; that God has been no more mindful of one race than of another, and is immanent in the universe, especially in intelligences; and "that our Bible, as the other Bibles of the world, is, in the higher sense, but the history of the attempts of the people to express the impressions made on the mind by God immanent in nature." He further seeks to discriminate between what is divine and what is human in religion, and to show that man may reasonably expect a future life.

THE CONSTANTS OF NATURE. Part I—A TABLE OF SPECIFIC GRAVITY FOR SOLIDS AND LIQUIDS. By FRANK WIGGLESWORTH CLARKE. Washington: Smithsonian Institution. Pp. 409.

THE author published, in 1872, through the Smithsonian Institution, a "Table of Specific Gravities, Boiling-Points, and Melting-Points for Solids and Liquids," which Prof. Henry made the first part of a work he was contemplating under the title of "The Constants of Nature." Other parts were contributed by Prof. Clarke, and one part by Prof. G. F. Becker. The present volume is in effect a new edition of Part I, revised, rearranged, and brought down as nearly as possible to the date of printing. The tables are, however, modified by the omission of boiling and melting points, except when those data seem essential to the proper identification of a compound, that want being supplied by Prof. Carnelley's tables. The tables contain the specific gravities of 5,227 distinct substances, and 14,465 separate determinations.

ENTOMOLOGY FOR BEGINNERS. By A. S. PACKARD. New York: Henry Holt & Co. Pp. 367. Price, $1.40.

THIS work, the author of which is an eminent naturalist, is intended for the use of young folks, fruit-growers, farmers, and gardeners. While amateurs and dilettant entomologists may find useful hints in it, "the needs of those who wish to make a serious study of these animals have not been overlooked, and it is hoped that the book will be of some service in leading such students to pay more attention to the modes of life, transformations, and structure of insects than has yet been done in this country." Promi-

nence is given to accounts of injurious insects, in regard to which, besides the matter here furnished, references are made to descriptive works and reports for fuller information. Some changes are made in classification. Believing that some of the lower orders, such as the "Orthoptera" and "Pseudo-neuroptera" are heterogeneous, unnatural groups, which ought to be broken up into distinct orders, sixteen orders instead of eight are formed. Considering that there are probably about a million species, this number is thought not to be too many. The general principles and descriptions are followed by particular accounts of insects injurious to agriculture, with prescriptions of remedies against them, and information on collecting and rearing insects, dissecting, preserving, and microscopic mounting, and a bibliography—"The Entomologist's Library."

OLD AND NEW ASTRONOMY. By RICHARD A. PROCTOR. London and New York: Longmans, Green & Co. In twelve monthly parts. Pp. 64, with two Plates each. Price, 2*s.* 6*d.* each.

THE first five parts of this work have been received. It was the design of the author to make it the great work of his life—the one, as he himself has said, for which all the treatises on astronomy that he had hitherto produced, and also his astronomical essays and lectures, were preparatory. The chief object of it is to present in popular yet scientifically sound form "those views of the heavenly bodies which are included in what, in his last poem, Tennyson calls the 'New Astronomy'"; the life-histories of worlds and suns, studies of the planets as illustrating the stages of our own earth's life, and of the record of the earth as illustrating the life-histories of the planets; of the sun as the one star we can examine, and thus as telling us all we know in detail about the nature of other suns, and of the stars as illustrating the life of the solar system. There are also presented points of detail in which the astronomy of to-day differs from the astronomy of a quarter of a century ago—relating, among other things, to the structure of the galaxy, the sun's condition and surroundings, the condition of the various orders of bodies attending on the sun, the recognition of the moon as presenting the history of our earth's past as well as future life, and comets and meteors. Fuller explanations than the old ones are given of the tides and the precession of the equinoxes. The illustrations are of prime excellence, and a large number of them original. We are not aware whether the author had completed his work; but, even if he has left it unfinished, that which is already published may be regarded as a valuable addition to astronomical literature, and as giving the "latest news" on the subject.

VIERTELJAHRESSCHRIFT ÜBER DIE FORTSCHRITTE AUF DEM GEBIETE DER CHEMIE DER NAHRUNGS- UND GENUSSMITTEL (Quarterly Review of Progress in the Chemistry of Foods and Condiments). Edited by Drs. A. HILGER, J. KÖNIG, R. KAYSER, and E. SELL. Vol. II. 1887. Berlin: Julius Springer. New York: B. Westermann & Co. Pp. 692. Price, 14 marks.

THE contents of this periodical, of which we have here the four numbers of the year stitched into one, hardly need any other description than the title. It is compactly filled with reports, analyses, receipts, statistics, and other matter related to the subject, given under such headings as "Meat," "Peptone and Meat Preparations," "Milk," "Oils," "Sugars," "Spices," "Fermentation-Phenomena," "Water and Water-Provision," "Preserves and Preserving Media," "Useful Articles," "Methods of Analysis," "Microscopic Investigations," "Laws," "Literature," and others of similar character. Only facts receive attention.

A SKETCH OF THE GERMANIC CONSTITUTION, FROM EARLY TIMES TO THE DISSOLUTION OF THE EMPIRE. By SAMUEL EPES TURNER, Ph. D. New York: G. P. Putnam's Sons. Pp. 185. Price, $1.25.

THOUGH concerning only the political changes achieved by a particular people among the European powers, the history of the Germanic Constitution at all epochs of its development is of general interest—in early times, because of the contributions which the Germanic stock made to the blood, language, laws, and customs of the various states; in later times, because of the controversies and wars that turned around German pretensions, and of the lead taken by Germany in the Reformation; and in the present, because of the prominence that is ac-

corded to German thought and German policies. The "sketch" begins with the accounts of the Germans given when they first began to attract attention by the Roman authors, and is continued by periods—the "Merovingian," "Carlovingian," "First Feudal," "Second Feudal," and "Reformation" periods, the "Period of Disintegration" and the "Period of Dissolution," ending in 1806. The Constitution of the new empire is not considered.

The third number of the proceedings of the *American Society for Psychical Research* (Damrell and Upham, 50 cents) opens with a paper, by Miss Alice C. Fletcher, on the "Supernatural among the Omaha Tribe of Indians," embracing myths regarding the origin of woman and the entrance of death into the world, beliefs about the fortunes of the spirit after death, and about ghosts, together with a variety of superstitions and legends. This is followed by a "Criticism on 'Phantasms of the Living,'" by Prof. C. S. Peirce, with "Remarks on Prof. Peirce's Paper," by Edmund Gurney, and "Mr. Peirce's Rejoinder." In his criticism, Prof. Peirce states sixteen conditions to which he says the thirty-one coincidences between a visual hallucination and a death, mentioned by Messrs. Gurney, Myers, and Podmore, ought to conform, but one or more of which are sinned against by every one of the thirty-one cases, and concludes that "the evidence, so far as it goes, seems to be rather unfavorable to the telepathic character of the phenomena." Mr. Gurney admits the weakness of a few cases, defends others, and gives additional evidence in support of some, but yields no important point. Prof. Peirce's rejoinder deals with the mathematical probabilities of the thirty-one cases being accidental coincidences, and reviews some of the cases in detail. This discussion is followed by brief reports from several committees. The experiments and investigations of the Committee on Thought-Transference had yielded little but negative results. The Committee on Experimental Psychology had received five hundred returns from a blank designed to test the prevalence of superstition regarding sitting down thirteen at table, beginning a voyage on Friday, seeing the new moon over the left shoulder, and occupying a house reputed to be haunted. Of three hundred and nine men, about one tenth were more or less influenced by the first three superstitions, and of one hundred and ninety-one women about two tenths. The form of the fourth question is not such as to separate the respondents who have a belief in the superstition from those who have not. The Committee on Apparitions and Haunted Houses deemed the last part of their designation a misnomer, as they had not been able to learn of any house which was reputed to be haunted at the present time. They reported a number of well-authenticated cases of presentiments, and stated that materials for their research were coming in quite freely. The Committee on Mediumistic Phenomena reported that professional materializing mediums could not be got to give *séances* under conditions suitable to a scientific investigation, and that where non-professional mediums had given such *séances* the results were negative. A paper by the chairman, on "The Basis of Investigation of Mediumistic Phenomena," was appended to the report. This is followed by two papers on hypnotism, and one on "The Consciousness of Lost Limbs."

"The American Folk-Lore Society" has been formed for "the study of folk-lore in general, and in particular the collection and publication of the folk-lore of North America." Its President is Prof. Child, of Harvard; William Wells Newell, of Cambridge, Mass., is the Secretary; and among its other officers are many well-known American anthropologists. Its medium of publication is *The Journal of American Folk-Lore* (Houghton, $3 a year), a quarterly magazine, the second number of which is before us. W. W. Newell is the general editor. This number contains ten articles, treating of Indian myths and customs, folk-lore of the Pennsylvania Germans, superstitions and tales of the negroes, etc., together with departments for notes, items, meanings of words, and titles of articles on folk-lore in American and foreign journals. The field to which the journal is devoted is exceedingly interesting and instructive, and is one in which the material for study should be seized upon at once, for it will soon be too late.

Part II, of Vol. IX, second series, of the *Journal of the Academy of Natural Sciences*

of Philadelphia, comprises a paper by W. B. Scott, entitled "On some New and Little-Known Creodonts," describing *Mesonyx obtusidens*, *Hyænodon horridus*, and several other species, with three plates, and a paper by Henry Fairfield Osborn, entitled "On the Structure and Classification of the Mesozoic Mammalia," with two plates, and a number of figures in the text.

The Elisha Mitchell Scientific Society (Chapel Hill, N. C.) gives evidence by its *Journal* that its fifth year has been one of activity and progress, and has contributed to the advancement of science in the South. Fifty-five papers have been presented to the society during the past year, dealing with subjects in chemistry, mathematics, ichthyology, entomology, meteorology, etc., a large part of which are published in the "Journal." Eight regular meetings were held during the year, and three public lectures delivered.

The first number of *Insect Life*, a periodical bulletin of the Division of Entomology, United States Department of Agriculture, appeared in July. It will be issued under the direction of Prof. C. V. Riley, United States Entomologist, and is designed to contain short papers, notes, and correspondence, which it is desirable to give to the public without delay, or which would be too disconnected for use in the annual reports or in the special bulletins of the division. The present number contains a variety of information, consisting of descriptions of several noxious insects, notes on the habits of others, and records of experience in using certain insect-exterminators, all of which promises well for the usefulness of the periodical.

In *Facts about Ireland*, Mr. *Alexander B. MacDowall* presents the condition of Ireland, and the changes it has undergone, in graphic diagrams or by curves (Edward Stanford, London). Under this system, plates are presented showing the relative changes in population in Ireland, England and Wales, Scotland, and London, by decades since 1801; and the statistics, in Ireland of agriculture, education, emigration, evictions, drunkenness, crime, consumption of spirits, bank deposits, revenue, value of crops, and occupations. Each plate is accompanied by a page of letterpress, calling attention to its significant points. The author hopes that these diagrams may prove of some little use in the study of the Irish question. They certainly show at a glance much that it would take considerable reading to learn otherwise.

The *Colloquia Latina* of Mr. *Benjamin D'Ooge*, of the Michigan State Normal School (D. C. Heath & Co.), is a collection of dialogues intended to form the basis for exercises in conversational Latin. It is the outgrowth of methods pursued by the author in his own classes, and most of the dialogues have been tested by actual use. Its purpose is to give greater interest and life to the study, and more thoroughness. The dialogues give the models or forms of expression, after which conversations may be carried on about the subjects, in Latin; while the notes elucidate the grammatical and idiomatic peculiarities which come under notice.

In *Selected Poems from Premières et Nouvelles Méditations* (D. C. Heath & Co.) Prof. *George O. Currie* has prepared a collection of Lamartine's poems, with notes, for schools and classes. The author represented is a poet of the highest merit—"the Christian Virgil, only greater, and just as pure and refined," in the editor's view—and the choice gives a fair test of his quality. Notes are appended, which are both grammatical and literary in character; a sketch of Lamartine's life is given; and an article by Prof. A. Williams, of Brown University, on the "General Character of French Verse," adds to the value of the work as a whole.

An Iceland Fisherman, by *Pierre Loti* (New York, Gottsberger), is a story by a French author of rising fame. His real name is Julien Viaud, and he served during the Franco-Chinese War on a French naval vessel. The adventures which befell him during his cruisings in the Oriental seas furnished him with materials for many vivid stories and sketches, which proved very acceptable to the public. The present story, though written among more quiet scenes at his home near Rochefort, is marked by similar qualities. The translation is acceptably done by Clara Cadiot.

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POPULAR MISCELLANY.

Death of Richard A. Proctor.—Mr. Richard Anthony Proctor, the distinguished writer and lecturer on astronomy and other subjects, died in this city, September 12th, of yellow fever. He had left his home at Oak Lawn, Florida, to go to England and fulfill some lecture engagements, and had engaged passage on one of the steamers appointed to sail on the following Saturday. He was apparently in good health, and there had been no yellow fever at Oak Lawn; but very soon after reaching his hotel he complained of being ill. A doctor was sent for. His disease rapidly developed. He was transferred to the Willard Parker Hospital, and died there, in less than sixty hours after he was first taken. A portrait of Mr. Proctor and a sketch of his life up to that time were given in the "Monthly" for February, 1874. His life has been a very busy one since then. He has written incessantly, contributing to journals of every kind, on a great variety of subjects, but always with the most interest on those relating to astronomy. A few years ago he started a periodical, first weekly, afterward monthly, called "Knowl-

edge," which was devoted principally to the popularization of science, and to which he was himself a voluminous contributor, writing on all sorts of subjects, from "Americanisms" and "Whist" to the purposes for which the Pyramids were built. He also wrote under a variety of signatures; in his own name, in astronomy; as "Edward Clodd," on dreams and evolution; as "Thomas Foster," on morals and other abstruse subjects; as "Mephisto," on chess; and as the editor of several departments. In his earlier life he accomplished something in original research, at which he would have gladly continued, but financial embarrassments compelled him to do that which would bring money at once—and hence the prolific fruits of his pen. In 1884 Mr. Proctor married, as his second wife, Mrs. Robert C. Mallery, of St. Joseph, Mo., where he lived till he removed to Florida in 1886. He had erected at Oak Lawn an observatory, where he was accustomed to spend much of his time, reviving the original work of his earlier days, and had been engaged in later years upon a book which he had intended to make the crowning work of his life and his most solid title to fame, "The Old and New Astronomy." It was to be published in twelve monthly parts, by Longmans, Green, and Longmans, London and New York. We are not informed whether the manuscript of this work has been completed; but we understand that the sixth part is now ready for delivery. One of the last articles he wrote was that in "Harper's Weekly" for September 22d, on the "Moon a Dead World (but not like our Earth)," in which he held that the differences in the character of the lunar and terrestrial surfaces are owing to differences in the extent to which denudation has worked on the respective bodies. He also left several manuscripts in the hands of one of the newspaper "syndicates."

The Teaching of Physics in Schools.—The Committee of the American Association on the Teaching of Physics expresses the opinion in its report that the teaching may begin with profit in the "grammar-school," but decidedly opposes any general recommendation that it must begin there or in the primary school. "Here, perhaps more than anywhere else, nearly everything depends upon the teacher." When taught in the grammar-school and by a competent teacher, it should be done mainly by and through illustrative experiments, which may be of the simplest character, involving and exhibiting some of the fundamental principles of the science; and these should generally be made by the teacher, the pupils being encouraged to repeat, vary, and extend. The course of study in the high-schools should be in harmony with the fact that the large majority of the young people who are educated in the public schools receive their final scholastic training there. It is important that the student should be made acquainted, if only to a limited extent, with the methods of physical investigation, and that he should be able himself to plan and carry out an attack upon some of the simpler problems of the science. In a high-school course of four years of three terms each, the study should not begin before the third year, and should be continued, with three hours a week of class-teaching, for one year—text-book work with illustrative experiments by the instructor during the first two terms, and simple laboratory exercises in the third term. A course like this should be required as preliminary to admission to all courses in college.

Ancient Egyptian Medicine.—The ancient Egyptians had abundant opportunities in performing the preparatory processes for embalming to become acquainted with the structure and some of the functions of man's physical system. Hence medicine flourished among them from an early date. Medical colleges existed in the priestly schools of Memphis, Heliopolis, Sais, and Thebes. Two nearly complete medical treatises of very great antiquity are still extant, and fragments of others. The Ebers papyrus, which is written in hieratic characters resembling those of the earlier writings of the eighteenth dynasty (B. C. about 1550), begins, after the conventional prefatory adjuration, with a section on hygienic measures and simple remedies. This is followed by a section on the parasite *Bilharzia hæmatobia*, which is still common in the Nile Valley. Other diseases are then treated of, including those of the eye, which have always been among the most serious afflictions of Egyptian life.

Twenty-four prescriptions for hair-washes, oils, depilatories, and dyes are given. Among them is one "to stimulate the growth of hair, prepared for Sesh, the mother of his Majesty King of Upper and Lower Egypt, Teta the blessed," which carries us back to the beginning of historic time, for Teta was the second king of the first dynasty, and his mother, Sesh, may have been the queen of Menes, the founder of the empire. Under the heading of "The Beginning of the Mystery of Medicine, Knowledge of the Motions of the Heart, and Knowledge of the Heart," are described the vessels "from it [the heart] to all parts"; "and it is the beginning of the vessels to each organ." Concerning the animal spirits, we are told that these vital spirits "enter one nostril, and penetrate to the heart through the tube which carries them into the body-cavity"; and "there are four vessels going to the two ears together, two on the right side, two on the left side, carrying the vital spirit into the one right ear, the breath of death into the left ear; that is, it enters on the right side, the breath of death enters on the left side."

Preglacial Cave-Men in Wales.—Dr. H. Hicks read in the British Association accounts of some explorations which he had carried on in certain Welsh caves as affording evidence of occupation by pleistocene men and animals before the glacial beds which occur in the area had been deposited. It was found that, although the caverns are now four hundred feet above the level of the sea, the materials within them had been disturbed by marine action since the pleistocene animals and man had occupied them. At Stet Cave a small, well-worked flint flake had been discovered beneath twenty feet of glacial beds. It seemed clear that the contents of the cavern must have been washed out by marine action during the great submergence in mid-glacial times, and then covered by marine sand and an upper bowlder-clay. The author believed that the flint implements, lance-heads, and scrapers found in the caverns were also of the same age as the flint flake; hence they must all have been the work of preglacial man. Prof. Boyd Dawkins accepted the evidence of the antiquity of man, and fully agreed with Dr. Hicks's conclusions. To Mr. W. Pengelly this was a "delicious discovery," inasmuch as he had long stood to a great extent alone in the opinion that the nodule flint tools in Kent's cavern were of preglacial make. The explorations are to be continued.

Subjects for Industrial Training.—Mrs. Laura Osborne Talbot thus described to the American Association her experiences of the effects of a little industrial teaching upon thirty vagrant boys whom she, with some other ladies, had induced to attend for three years an industrial class at Howard University one morning in the week: "We were limited in every way, but we found these children of the lowest kind were delighted to work with tools, and some of them have set up little carpenter-shops of their own, and support themselves in that way. The moral uplifting was the best result of all, and it is not likely that these boys will become members of our criminal class. Each boy as he entered the class was taught in the tailor-shop to mend his clothes, and in the shoe-shop to mend his shoes. One lame colored boy from the orphan asylum became so skillful in shoemaking that he could not only make his own shoes, but could cut up the larger, half-worn shoes and make them over for baby feet. All of this I term the best kind of economy, especially in a city like Washington.

Contents of a North Carolina Mound.—Mr. J. M. Spainhour has described, in the Elisha Mitchel Scientific Society, some relics that were discovered in the excavation of a mound in Caldwell County, N. C. Within the mound was found a skeleton lying upon its face, with the head resting in a large sea-shell, the inner surface of which was carved with hieroglyphics. Around the neck were large beads made of sea-shells. The arms were extended and bent at the elbows, so as to bring the hands within about a foot of the head. Around each wrist was a bracelet, composed of copper and shell beads, alternating. The copper beads appeared to have been hammered into thin sheets and rolled around the string, a part of which was preserved. Near the right hand was an iron implement like a chisel or punch, not sharp-pointed, but smaller at the end away from the handle. The left hand was resting

on the convex surface of a sea-shell, the concave surface of which contained about a hundred small beads. The shell was carved with hieroglyphics. Two other skeletons, on either side of this one, also had their heads resting in the concave surfaces of shells, which were marked with hieroglyphics. Several other skeletons were found around and above the principal one, which was thought to be the remains of a chief. In another part of the cemetery were found skeletons of persons who had evidently been buried alive, their limbs having been held down by large stones placed upon them.

Sanitary Plumbing.—Dr. Sinclair White, recently medical officer of health at Sheffield, England, in a late sanitary report, recommends, for use among the poorer and less intelligent inhabitants of towns, the form of multiple water-closet known as the trough-closet or water latrine. The trough is composed of strong glazed earthenware, in sections, with a seat to each section. The seats are separated by partitions. The trough may comprise any number of sections. A pipe from a flush-tank enters one end, and it has a connection with the sewer at the other, a trap and inspection hole intervening. Water stands in the trough to the depth of three or four inches, and it may be flushed automatically or by hand.

Important Archæological Monuments.—The American Association's Committee on the Preservation of Archæologic Remains recommended that measures be taken for the preservation of the following works: Chaco Cañon, from the forks of Escavada Cañon for a distance of eight miles up; Cañon de Chelly, Cañon del Muerto, and Walnut Cañon; the ruin of Fossil Creek, on the east branch of the Rio Verde, and about fifteen miles south of Camp Verde military reservation; ruins in Mancas Cañon, the Round Towers situated on the flat valleys of the Lower Mancas, and the Cavate Lodges in the cinder-cone, about eight miles east of Flagstaff, Arizona Territory. The report continues: "Besides these groups of ruins and dwellings, there are isolated remains in the Territories of New Mexico, Arizona, and Utah, numbering over forty, which demand preservation. The Pueblos, which are not on treaty reservations or grants, and the old Mandan and Arickaree village on the Port Berthold Indian reservation in Dakota, to be preserved when they cease to be inhabited by the Indians. Also certain burial and village sites in Alaska." The committee—Alice C. Fletcher and T. E. Stevenson—have caused a bill to be introduced in Congress providing for a reservation in New Mexico for the purpose of archæological study.

Uses of Photography in Science.—In describing some of the applications of photography to scientific purposes, Mr. H. Trueman Wood mentions, as among the advantages of the art for such uses, that it is an absolutely unprejudiced observer. The sensitive plate records, with absolute fidelity, the image thrown upon it. The sensitive surface further has the power of storing up feeble impressions of light, so that an image is produced by the long-continued impact of vibrations too feeble to have any effect until they have been allowed to impinge upon the plate for a considerable time; while, on the other hand, the light-rays, if of sufficient energy, can produce their due effect in a time which, to human appreciation, seems infinitely small. Again, the photographic plate is affected by rays to which the eye is quite insensitive, and thus by its aid we can take cognizance of, and observe, rays beyond the limits of the visible spectrum, of the highest and of the lowest refrangibility. Thus, the photographic lens will record the impression of an infinite amount of detail, to reproduce which by any other method would require immense time and labor. The most important services which have been rendered by photography to science are in astronomy; in photographs of the moon, of the sun, and of eclipses, in which possibly evanescent phenomena are put on permanent record for the study of after-years. The work of cataloguing and charting the stars, and accurately locating them, has been greatly aided; has been, in fact, set in a new aspect by means of photography. Then we have the photographs of the nebulæ, one of which, Mr. Common's view of the nebula in Orion, Mr. Lockyer has declared to be one of the greatest achievements in astronomy, of a value greater than that of all the eye-observations made during

the past two and a half centuries. In astronomical spectroscopy, by which great discoveries have been made respecting the constitution of the heavenly bodies, photography has had it all its own way. Meteorologists have made use of photography in various ways, as in application to self-recording instruments of various kinds, and in observations of cloud-forms and distances, and of lightning. In chemistry and physics, the best photographic work has been done by the camera when allied with the spectroscope. In the biological sciences and in medicine the applications of photography have been many and various. Anthropology finds a valuable aid in photography, which reproduces and perpetuates the types and peculiarities of races and of individuals. In the study of natural history, probably the most important work done by photography lies in the direction of photo-micrography; and in such researches as those of Mr. Muybridge and M. Marey on animal locomotion. The value of photography in geographical science is now so well admitted that an explorer would almost as soon think of starting without a rifle as without a camera.

Time-Reckoning of Puget-Sound Indians.—According to Mr. M. Eells's account of "The Indians of Puget Sound," in the "American Antiquarian," the Nisquallies divide the year into thirteen moons, for each of which they have separate names; also for the waxing and waning of the moon. The daytime is divided into dawn, sunrise, forenoon, noon, afternoon, sunset, and dusk, while the night has the single division of midnight. These Indians obtained the idea of Sunday from another tribe, before the English came, and after that met on Sunday, sang, danced, prayed, and tried to purify themselves, and throw away their bad and make their hearts good. They also married wives on that day. Among the Twanas Sunday means holy day, and the other days are day past, two days past, etc., except Saturday, which means "alongside," that is, of Sunday. March is "getting warm"; August, "the deer sheds its horns"; October, "the grass dies"; and November, "the grass goes into the ground." The people are generally in debt to one another, with obligations of many years' standing. The debts are seldom heard of except when trouble arises about something else, and then there is a general turning up of old scores for ten or fifteen years back, and of the debts of relatives and wife's relatives. At one time, says Mr. Eells, an old Indian living at Seabeck was invited to a potlatch at Skokomish; he accepted the invitation, but while attending the feast his house was broken into and robbed of property of considerable value. As he could not find the trespasser, he claimed that the man who invited him to the potlatch ought to pay him; because, if the giver of the potlatch had not induced him to leave home, he would not have lost the articles."

An Evil of Civilization.—A curious account of the Yakutal Indians was given by Prof. William Libbey, Jr., in the American Association. The author mentioned the strength of the men as contrasted with the bent, labor-wasted bodies of the women, their aptness in mechanical arts, their strict idea of property, their superstitions, which are valuable as influencing fortune. A whole tribe got baptized to change their luck, and, when their luck did not change, the missionary had to. Their rapid decrease in numbers was due to changes in diet and clothing. In their climate the canned beef and cotton overalls of the white man proved poor substitutes for seal-fat on the inside and seal-skin without.

Lucigen.—By the "lucigen" apparatus, according to Mr. J. B. Hannay, a light is obtained from the burning of crude oil which exceeds in effective illuminating power any artificial light yet invented. The working of it depends upon the action on a powerful jet of mixed spray, hot air, and hydrocarbon vapor, driven by compressed air, of an aspirated sheet of hot air derived from the atmosphere. The flame takes the shape of a cylinder, tapering at both ends, about three feet long by nine inches in diameter, is intensely white, and is without smoke or smell. In this form it is available for open spaces and workshops, where a lateral diffusion of light is wanted. Modifications are imposed upon the apparatus to adapt it to almost every kind of building and work where it is desired to cast a large illumination over an

irregular space. In one form, a light of from nine to eleven thousand candle-power, "actual," is obtained, which can only be compared with a conflagration. The size of the flame is so large that the shadows it casts are nebulous at the edges, and the volume of light so great that the shadows are partially illuminated by the reflections from surrounding objects, and the sharp contrasts and black shadows of the electric light are avoided. The same principle is adapted for heating purposes in the pyrigen, which gives a furnace free from sulphur, dust, and free oxygen, and of an absolutely steady temperature. The advantages are claimed for lucigen of low cost—it being one tenth that of gas-light of corresponding power—and extreme simplicity.

Fifty Years of Sanitary Work.—The progress of sanitation in England during the fifty years of the Queen's reign has been reviewed by Captain Douglas Galton. Affairs were in a bad condition at the beginning of the history, in the absence of systematic methods of counteracting the natural accumulation and operation of propagating conditions of disease. Parochial administrations operated mischievously, in degrading the habitations of the working-classes and checking tendencies to improvement. The window-tax had been in operation one hundred and fifty years, to foster darkness and bar out ventilation. Water-supplies and the disposal of sewage had hardly been thought of, except in the larger towns. The first complete registration of vital statistics was made in 1838. A report of the Poor-Law Commissioners on sanitary conditions embodied many recommendations and principles that have since been recognized in legislation. It is now computed that by means of the measures that have been made effective, the annual saving of lives, over the previously prevailing death-rate, was, during 1860–'70, 4,064; during 1870–'80, 13,929; and from 1880 to 1884, 21,847. The whole death-rate for England and Wales has been reduced from 22·07 to 19·62 per 1,000; of deaths by zymotic diseases, from 4·52 to 2·71 per 1,000. The improvement in the last point in urban districts does not, however, appear to have kept pace with that in rural districts. The present social condition of the people affords other evidence of general improvement. The main feature of the legislation of the past half-century is the recognition of the principle that when large numbers are congregated in communities the duty of preventing injury from this aggregation rests on the community.

The Relation of Roots to Moisture.—Variations in plants are often produced by differences in conditions of the environment which are imperceptible to the observer; so that different plants, proceeding from seeds of the same pod and growing close together, are hardly ever precisely alike. Mr. H. Marshall Ward has shown how variations may be occasioned by conditions affecting the root. The active roots are furnished with fine hairs, which go out and draw in the moisture. The drier the soil and the more difficult to get moisture from it, the more thickly set generally are the hairs. The soil consists of innumerable fine particles, of different shapes, sizes, and composition, and each of these particles is covered with a thin layer of water, a water-blanket, which adheres to it tenaciously; although, when the moisture-coating exceeds a certain thickness, they will yield the surplus up quite readily. There are spaces between these particles, each enveloped in its water-blanket, and these interspaces influence the quantity of water which can be held back by the soil. If we can suppose a soil to be perfectly dry, the interspaces will be filled with air; when the soil is made moist, some of this air is driven out as the water comes in to take its place. If the soil is made excessively wet, all or nearly all the air may be driven out, though this seldom happens. The functions of the root-hairs are chiefly to apply themselves in the closest manner to the surfaces of the particles of the soil, so that the water attached to them can pass from the soil to the plant, and, with it, whatever dissolved matter it may contain. Some of this matter is oxygen dissolved from the air-bubbles, and this oxygen is essential to the life of the root-hairs. The effect of the deprival of oxygen is then gradually to cause the death of the root-hairs, then of the rootlets, the larger roots, and so on, till the whole plant perishes. This may take considerable time

in large plants, but the process is continually going on; and it is what occurs in plants growing in an overwet soil. In an open, well-aërated soil, on the other hand, even though it be apparently very dry, the root-hairs multiply and develop an astonishing power to find and absorb water; and a healthy, well-rooted plant can take up water from a soil which is to all appearance air-dry; whereas a plant which has not had time to develop its root-hairs in sufficient numbers to take in the firmly adherent water-films from numerous particles of soil would droop and wither. Soils are suitable for particular plants or not, according as they can or not, under the circumstances, afford the air at the roots that the plants need. Many plants flourish in an open soil with plenty of sand in it, but will not grow in a stiff, wet soil. The heavier soil is unfavorable, not necessarily because it does not contain the right food-materials, but because its particles are so small, so closely packed, and so retentive of moisture, that the root-hairs do not obtain sufficient oxygen. Root-hairs and roots can not grow or act unless the temperature is favorable; and a close, wet soil may be too cold for the roots at a time when an open, drier soil (exposed to similar conditions as regards sunshine, etc.) would have a degree of warmth favorable to their growth. The opening up of stiffer soils by the various processes in use is to be regarded as a means of letting in air, and therefore oxygen, to the roots.

The Cost of wasting Coal.—Prof. Chandler Roberts estimates the weight of the smoke-cloud which daily hangs over London at about fifty tons of solid carbon, and two hundred and fifty tons of carbon in the form of hydrocarbon and carbonic-oxide gases. Calculated from the average result of tests made by the Smoke Abatement Committee, the value of coal wasted from domestic grates reaches, upon the annual consumption of five millions of people, to £2,257,500. The cost of cartage on this wasted coal is calculated to be £268,750; while the unnecessary passage of about 1,500,000 horses through the streets in drawing it adds very seriously to the cost of street cleaning and repairing. Then there is the cost of taking away the extra ashes, £43,000 a year. Summing it all up, the direct and indirect cost of the wasted coal may be set down at £2,600,000, plus the additional loss from the damage done to property caused by the smoky atmosphere, estimated by Mr. Chadwick at £2,000,000—the whole amounting to £4,600,000, or $23,000,000.

Wolf-nursed Children.—In "An Account of Wolves nurturing Children in their Dens," published in 1852, by Colonel Sleeman, an experienced officer of the Indian army, are recorded a number of such cases as are indicated in the title. In one instance, near Sultanpoor, in 1847, a wolf was seen to leave her den, followed by three whelps and a little boy. The boy went on all-fours, and ran as fast as the whelps could. He was caught with difficulty, and had to be tied to keep him from rushing into holes and dens. He was alarmed when grown-up persons came near him, and tried to steal away. But if it was a child, he would rush at it with a fierce snarl, like a dog's, and try to bite it. He rejected cooked meat, but seized raw meat greedily, put it on the ground under his hands, like a dog, and ate it with evident pleasure. He would not let any one come near him while he was eating, but made no objection to a dog coming and sharing his food with him. He died in August, 1850, and after his death it was remembered that he had never been known to laugh or smile. He used signs when he wanted anything, but very few of them except when hungry, and then pointed to his mouth. When his food was placed at some distance from him, he would run to it on all-fours, but at other times he would occasionally walk upright. He shunned human beings, and seemed to care for nothing but eating.

Consanguineous Marriages.—Dr. Shuttleworth some time ago communicated to the British Medical Association the results of the inquiries which he had made into the influence of consanguineous marriages on offspring. For want of a uniform basis for comparison, positively accurate conclusions are hard to reach. His opinion on the subject, generally expressed, is that "first-cousin marriages are to some extent favorable to the production of idiot children." Extending his inquiries to the life-histories of the

parents, he found that in the greater number of cases causes of idiocy could be discovered in addition to or independently of consanguinity. This is in harmony with the conclusion published by Dr. C. F. Withington, that morbid inheritance rather than specific degenerative tendency will account for all the infirmities met with in the offspring of cousins. We may therefore assume that "the great danger in the intermarriage of cousins lies in the circumstance that when there is a neurotic inheritance, there are two certain morbid factors to contend with rather than a possible one." On the whole, "the balance of evidence would appear to be in favor of the conclusion that where a close scrutiny fails to discover any heritable weakness, neurotic or otherwise, consanguineous marriage *per se* is not necessarily a thing to be prohibited."

The Senses of Animals.—In a lecture on "The Sense and Senses of Animals," Sir John Lubbock, after relating his experiments in teaching his dog to read, and another experiment from which he concluded that the dog could not distinguish color, said that he had always felt a great longing to know how the world appeared to the lower animals. It was still a doubtful point whether ants were able to hear. He had concluded, from his experiments, that they had not the power of addressing each other. His impression, on the whole, was that bees and ants were not deaf, but that they heard sounds so shrill as to be beyond our hearing. There was no doubt about insects seeing. The colors of objects must present a very different impression upon insects from that on human beings. The world to them might be full of music which we could not hear, colors we could not see, and sensations which we could not feel.

The History of a New Britain Papuan.—The Rev. George Brown, a missionary, gave in the British Association an account of the life-history of a native of the island of New Britain. When a child is born to the Papuan people of the country, a warm banana-leaf is wrapped around his body, and he is fed with the expressed juice of the cocoanut; ever after which he is left to be "dressed in pure sunshine." On the occasion of the marriage of the youth, there is an interchange of goods and a distinct payment for the wife. Presents are also given by the women to the bride, and by the men to the husband—a broom to the former and a spear to the latter—after which a stick is given to the man. The spear means that the husband must protect his wife, the broom that with it she must do her household work, and the stick is the symbol of the man's authority. In case of a death, the dead person is appealed to to come back, and is expostulated with for having left his friends, and entreated to say how his friends have offended him. The people have a definite idea of a future state, and of the punishment of one offender, the niggardly man. When an old man is about to die, he is placed upon a litter and carried round to see the scenes among which he has passed his life, and is then taken back to wait his time. After death the body is placed in a sitting posture and taken into the public square, with the man's weapons by his side, and the people place offerings of goods and money before it.

The Brazilian Barrancas.—Some of the upland regions of Brazil, especially near the city of Barbacena, are marked by the appearance of great rugged hollows in the sides and slopes of many of the rolling, grass-covered hills. They are land-slips, caused by the existence of springs, and present an appearance picturesque in the extreme. Their sides are worn into every imaginable shape, of pinnacles, domes, pointed towers, buttresses, and cavities, with ravines narrow, deep, and precipitous, or wide, open spaces, surrounded by lofty perpendicular walls, riven by creeks, and ready to fall. But their great charm lies in their color. The prevailing tint is a deep Indian red, which, combined with the green hills and the blue sky, bearing its glistening white clouds, constitutes a charming combination of tones. Any one of these barrancas, as they are called, offers excellent opportunities to the geologist. In many of them are found lying upon beds of sandstone, near the floor of the hollow, extensive deposits of fine laminated clays, varying in thickness, but frequently divided into layers like sheets of paper, with varieties of colors,

pink, blue, white, black, gray, orange, crimson, purple, and yellow, lying side by side. Prof. Agassiz described precisely similar formations in the valley of the Amazon. Many of these barrancas show an upper stratum of white or yellow quartz conglomerate exceedingly rich in gold; and gold can often be got out of the surrounding earth from the top to the bottom of the sides, the hill being, as it were, literally "peppered" with the precious metal.

Mingrelian Rituals.—The people of Mingrelia, in the Caucasus, although professedly Christians, are, according to Freiherr von Guttner, addicted to practices and sacrifices that smack of heathenism. Offerings are established for all kinds of occasions, which every countryman can tale off on his fingers at will. Days are set for services to insure the protection of live-stock against disease. The most imposing of these is in behalf of the horse. Cakes are baked, on which is impressed the image of a horse or horse-shoe, and are cast into a hollow tree, drenched with wine and blessed by the priest, while the participants in the sacrifice hop around the tree and imitate the capering and neighing of horses. In case a person has the measles, he and his attendants are dressed in red and the room is hung with the same color and adorned with red flowers, while care is taken not to irritate the demon by using a cutting instrument or admitting a dog. For diseases of the eye, little round cakes are made furnished with inserted pupils to resemble an eye, and then swung before the eyes of the patient. The priests are cognizant of these offerings, and are said, in fact, to get the best part of the gifts.

Melting away of the Mongolian Loess.—The process by which caves, sink-holes, and ravines are slowly formed in limestone has been observed by M. Potanin as going on rapidly in the loess of Mongolia. The loess is moved by water, and transported from higher to lower regions with about the same facility and steadiness as the shifting sands are moved by the wind. The underground water which filtrates through it begins by making in it a kind of cavern; then a circular crevice appears on the surface over the cavern, and a cylindrical vertical hollow, which soon becomes a deep well, is formed through the thickness of the upper layers of the formation. The whole surface of the loess deposits is dotted with such wells, which are very dangerous to cattle. By and by the formerly cylindrical well begins to extend in the direction in which the underground water flows, and a narrow ravine grows until it joins the main valley. The ravine continually increases in width by falls of new masses of loess, and the whole is steadily carried "down-stream" by the water.

How a Desert was made Productive.—Dr. G. V. Poore has told the way in which the Landes of France have been reclaimed and made habitable by carrying out the plans first applied by Bremontier at about the beginning of this century. By reason of the light character of the sands of the region, and its exposure to the powerful winds of the Bay of Biscay, its drainage presented special difficulties, which could not be overcome by the ordinary resources of engineering. Recognizing that it was useless to contend against the forces of nature, Bremontier determined to try to make use of them for the accomplishment of his purpose. Knowing the virtues of planting and promoting the growth of a network of roots, he planted a tract of the dunes with peas, which would grow in the sand and send their roots to a considerable depth; and, for more permanent effect, with the maritime pine. The pine-seeds were sown mixed with seeds of the common broom, whose shrubs might serve as nurse-plants to the infant pines, and the sowings were made in a direction at right angles to the prevailing wind. A screen of hurdles made of gorse or of planks deeply driven into the sand was placed on the windward side of the seed-ground, and the seed-ground itself was thatched with pine-branches and other suitable material. In the course of time the brooms reached their full growth, while the pines continued to grow, overtopped them, and crowded them out. The maritime pines have grown well and have proved a very profitable tree, yielding moderately good timber and much turpentine; in addition to which a good business is done in charcoal. Thus the waste moorlands on the shores of

the Bay of Biscay have become of great commercial value. The railway journey of four or five hours from Bordeaux to Bayonne is now made through a long, monotonous pine-forest. The cultivation of the pine improves the soil, which is gradually enriched and altered in quality by the dead leaves and other vegetable *débris* which fall upon it. In some places clearings have been made in the forests and vineyards planted.

The Colorado Oil-Field.—According to Prof. Newberry's description in the American Association, the oil-field recently discovered in Colorado is situated in the valley of the Arkansas, above Pueblo, about the town of Florence. The geological formation is middle cretaceous, the Laramie coal series (upper cretaceous) forming the table-land on either side of the valley, the oil-wells being bored in the Colorado shales (middle cretaceous). These shales are highly carbonaceous, and have a thickness of about three thousand feet. About twenty wells have been bored, mostly to the depth of from eleven to sixteen hundred feet; some fourteen are now pumping, and yield from eight hundred to a thousand barrels per day. The oil is of excellent quality, has a green color, and an agreeable odor. It yields on distillation forty per cent of excellent burning-fluid, and nearly sixty per cent of superior lubricating oil, which contains much more paraffine than the oil of Pennsylvania. The average yield of the wells is nearly sixty barrels. This is larger than the average yield of the Pennsylvania wells, but there are no great "gushers" or fountain-wells. The oil-field of the Arkansas Valley is extensive, and the yield of oil may apparently be increased indefinitely. At present there is no sale for the lubricating oil, but, when an outlet is opened to that by way of the Gulf of Mexico, the oil industry may be expected to become very important and remunerative. The source of the oil is undoubtedly the carbonaceous matter of the Colorado black shale, from which it is being spontaneously distilled.

Deaths by Wild Beasts in India.—Conditions of peril from wild beasts and snakes exist in India of which it is hard to form an adequate conception in a country like ours. The death-list from these causes has, during the last four years, averaged more than 22,500. Of 22,817 deaths in one of these years, 20,142 were caused by snakes, leaving 2,675 to be ascribed to wild beasts. Last year's returns also mention 60,000 head of cattle as killed by these agencies, of which snakes were, however, responsible for only 2,000, while 20,000 each were ascribed to leopards and tigers. The apathy of the natives in the face of this destruction would be astonishing to a Westerner, as would also their remissness in clearing out places where these nuisances abound.

NOTES.

THE article on "Bird Courts of Justice" in the last number of the "Monthly" should have been credited to "Chambers's Journal," from which it was, with a few adaptations and abbreviations, compiled.

COMMITTEES were appointed by the American Association at its Cleveland meeting as follows: Committee on Chemistry Teaching —W. H. Seaman, W. L. Dudley, H. W. Wiley, W. O. Atwater, and W. A. Noyes; Committee on Water Analysis—O. C. Caldwell, J. W. Langley, J. A. Myers, W. P. Mason, R. B. Warder, and W. H. Seaman; Committee to confer concerning the Organization of a National Chemical Society—A. B. Prescott, Alfred Springer, and Edward Hart. Dr. A. B. Prescott was substituted for Dr. Scudder on the Committee on indexing Chemical Literature.

IN a paper read by Dr. Franz Boas before the American Association, on "The Development of the Civilization of the North American Indian," the legends of the various tribes are discussed, and it is shown that, notwithstanding their general similarity, the mythology of each tribe is founded on a separate basis. Thus it is shown that the common culture of the tribes of the northwest coast of America is not uniform, and the influence of one of them is more particularly traced. This culture should be analyzed more carefully before any comparisons with Asiatic and Polynesian tribes can be successfully made.

PROF. B. E. FERNOW, having shown in the American Association that the prevailing definitions of a tree—as distinguished from a shrub—are various and inexact, proposed this: "Trees are woody plants, the seed of which has the inherent capacity (potential energy) of producing naturally within their field of distribution one main, erect axis (single stem or trunk), not divided at or near the ground (bearing a crown), the primary axis continuing to grow for a number of years more vigorously than the lateral axis, and the lower branches dying off in time."

STEPS were taken at the recent meeting of the American Association for the formation of an American Geological Society. A constitution was adopted, under which the society will consist of not less than a hundred Fellows, and will meet annually during the Christmas holidays, with a second meeting in connection with that of the American Association. The committee under whose charge this action was taken, of which President Alexander Winchell is chairman, was continued as a committee to secure members.

FROM examinations of certain waters—one of them being a "mineral" water free from all possible sources of contamination—in which free ammonia was present—Prof. E. H. S. Bailey remarked, in the American Association, that he was inclined to consider that that substance may be sometimes a natural constituent, and not indicative of any pollution, of the water.

AUSTRALIAN experiences prove it bad policy to offer scalp-bounties for the destruction of animal pests. Such bounties have been offered for the rabbit pest, and, encouraged by them, a class of professional rabbit-hunters has sprung up, who carefully nourish the supply of their profitable game, and see that the natural enemies of the rabbits, which might do a great deal to limit their increase, are kept down.

A STUDY has been made by Prof. T. G. Bonney of the rounding of pebbles by the Alpine torrents and rivers. From this it appears that pebbles are rounded with comparative rapidity when the descent of the stream is rapid, and they are dashed down rocky slopes by a roaring torrent capable of sweeping along blocks of much greater volume; while the rounding takes place with comparative slowness when the descent is gentle and the average fall of the river is about adequate to push them along in its bed.

THE International Congress of Americanists, which meets in Berlin October 2d to 5th, will discuss, on the first day, questions relating to the discovery of the New World, to the history of America before the time of Columbus, and to American geology; the second day, subjects of archæology; the third day, those of anthropology and ethnology; and the fourth day, philology and palæography.

COMPARATIVELY little attention was given by the medical profession to the treatment of sprains till in 1870 or 1871, when Sir James Paget urged the investigation of the subject and the institution of scientific methods in the matter. Dr. Wharton Hood afterward published in the "Lancet" an account of the methods followed by the professional bone-setters of the public, which, with some blunders, were attended with considerable success. A full treatise on the subject has recently been published in London by Dr. G. W. Mansell Moulin. This author recommends a treatment chiefly hydropathic, with the avoidance of such lotions and liniments as arnica and rhus toxicodendron; an accurately measured rest, followed by moderate and careful movements, and suitably adapted massage.

PARASITIC fishes—extremely small beings, shaped like an eel—have been recognized only for a relatively short time. Ten species have been distinguished in different seas and oceans. They usually attach themselves to some hollow part of the bodies of marine animals, preferably entering the respiratory cavities of star-fish. They have even been found in the interior of the shells of pearl-oysters. They do not injure the animals with which they associate themselves, for they do not live upon them, but upon the minute organisms which the sea-water brings to their cavities, so that they are really commensals rather than parasites.

THE property which platinum and palladium display of throwing off flakes of their substance when under the influence of a strong electric current is due to the gases which they have occluded. Gold exhibits it in a less degree, and it may be that the old experiment of exploding wires by the discharge from Leyden-jar batteries depends upon the outbursts of occluded gases. The same property of occlusion exists in carbon, and has to be taken account of in the manufacture of incandescent lamps, from the wicks of which the gases must be driven out previous to using, else there will be no durability to them.

MR. MARIES, superintendent of the gardens of the Maharajah of Durbunga, India, has succeeded in reclaiming a tract of waste saline soil, in which not even weeds would grow, by digging down to the depth of two feet and planting thickly at the beginning of the rainy season with trees that had been grown in pots. In three years the ground was filled with roots, and to all appearances the salt had gone. When the trees were thinned out in 1887, the soil was found to be in good condition. Similar experiments have been successfully carried out in other places. Various kinds of trees were employed in the reclaiming operations, but the best were the *Inga saman*, or rain-tree, and the *Albizzia procera*.

LAST year's coroners' inquests in England furnished two examples of death resulting from tight-lacing. The last case was of a young lady suffering from fatty infiltration of the heart, who died suddenly while dressing hastily after a hearty meal. The corset was proved to have had a close agency in determining the fatal result.

In a communication on injuries by lightning in Africa, Emin Pasha shows that in the central regions (from latitude 2° to 6° north) they are of average frequency, while further north, as at Fashoda, Khartoum, and Berber, they are nearly unheard of. A belief prevails among the Soudan Arabs that with every flash of lightning a piece of meteoric iron is thrown to the earth. They fancy that whoever is able to secure such a piece of iron has gained a great treasure, because swords and knives made from it can not be surpassed in quality, and their possession gives immunity from danger in battle, and protection against lightning-strokes. Sheik Narr, chief of the Takkala Mountains, is said to have resisted all Egyptian attacks, and to have preserved his people's independence, through the possession of such a sword.

Antipyrine, an artificial alkaloid obtained from coal-tar, is recommended by M. E. Dupuy and M. Ossian-Bonnet as a remedy for sea-sickness. M. Dupuy asserts that, administered for three days before embarking and during the first three days of the voyage, in doses of three grammes a day, it prevented sea-sickness during the voyage across the Atlantic. M. Ossian-Bonnet usually obtained effects in ten minutes from a dose of one and a half gramme, and in no case had to use more than three grammes in two doses. When the stomach would not hold the medicine, a subcutaneous injection was efficient.

M. de Chardonnet has artificially produced a substance having the apparent qualities of silk. He treats the ethereal solution of cellulose with a similar solution of perchloride of iron or perchloride of tin, and, adding an alcoholic solution of tannic acid, obtains a substance that can be drawn out into a thread. These threads, which may be spun into stronger cords, are supple, transparent, and cylindrical or flattened; silky to the look and the touch; break with a weight of twenty-five kilogrammes per square millimetre; burn without the fire extending; are slowly decomposed by heating; are not acted upon by acids and alkalies of moderate degrees of concentration, water, alcohol, or ether; but are dissolved in etherated alcohol and acetic ether.

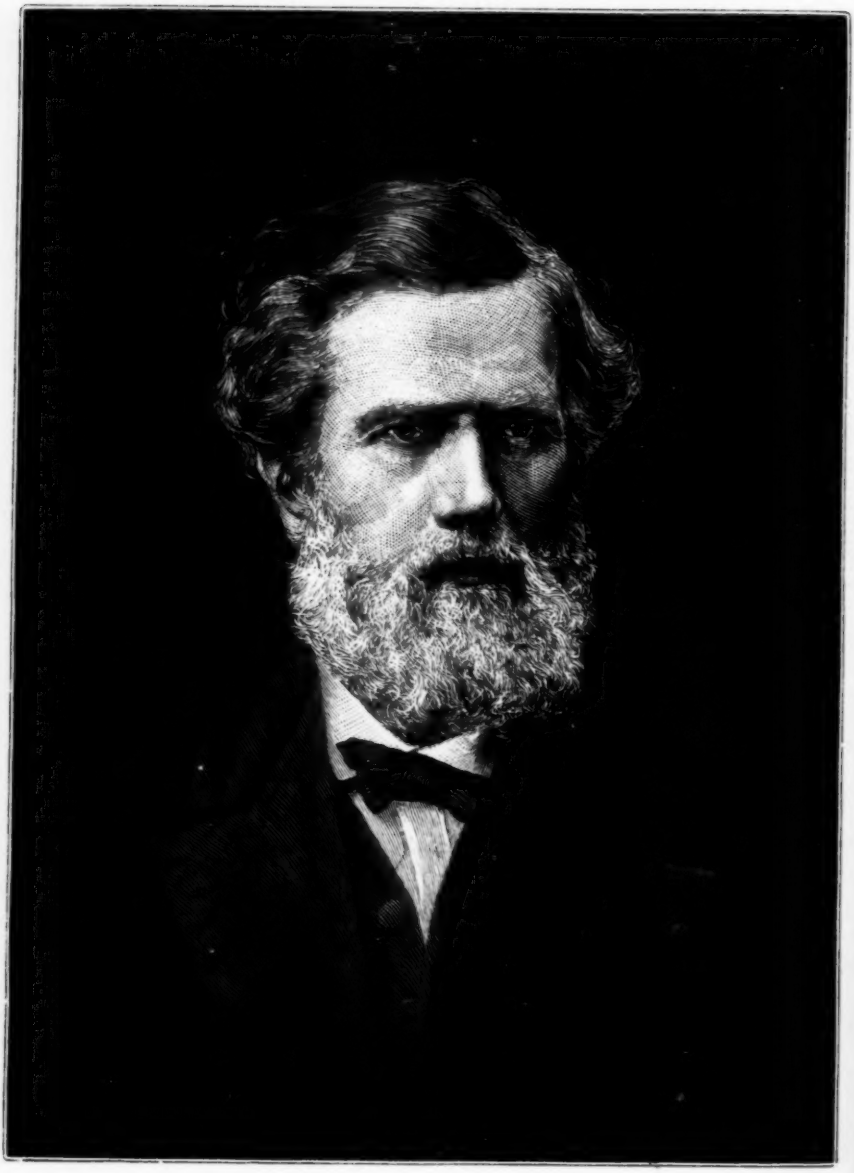
The Belgian Government, after experiments to ascertain the best methods of making the clothing of its soldiers water-proof, has adopted that of bathing the goods in acetate of alumina, and then drying them in the air, without wringing. The doctors have expressed the opinion that clothing thus prepared offers no obstacle to perspiration, and is therefore hygienically unobjectionable. It appears also to be determined that the goods are not depreciated either in quality or color by the preparation. The only serious objection to the process is its cost.

While the question of the origin of the Aryans is under discussion, Mr. G. Bertin suggests that we may learn something of it by looking further than we have yet done into the roots of their languages. Even in the oldest specimens they bear evidence of being hybrids—in inconsistencies of syntax; in the promiscuous use of prepositions and postpositions; in having many words and roots to express the same objects; and in the use of three genders. Hence the original tongue may have been a fusion of two languages—say of Accadian or some closely related speech and some Semitic language. The supposition is supported by the fact that a great many resemblances have been observed between Accadian and Sanskrit.

A new view of fetichism is taken by Major A. B. Ellis, in his book on the "Tshi-speaking Peoples of the Gold Coast." He does not think it characteristic of primitive peoples, or of races low in the scale of civilization, but believes that it is arrived at only after considerable progress has been made in religious ideas, when the older form of religions becomes secondary. And "it owes its existence to the confusion of the tangible with the intangible, of the material with the immaterial; to the belief in the indwelling god being gradually lost sight of, until the power, originally believed to belong to the god, is finally attributed to the tangible and inanimate object itself."

Some recent comparative analyses, made at Dundee, Scotland, of the air of sewers and that of the close rooms of some of the well-inhabited houses of the city, turned out to the advantage of the sewers. That is, the analysts found in small and ill-ventilated houses more carbonic acid, more organic matter, and far more micro-organisms than in the sewer-air they examined; so that, if the experiments were to be taken as final and conclusive, the inhabitants of a small room would improve their position by living in the atmosphere of a sewer! The experiments are, of course, not to be thus taken; but it is easy to conceive of cases in which the inference would be correct. The lesson to be drawn from it would be, not that sewer-air is less dangerous than it is thought to be, but an admonition of the necessity for improving the sanitary condition of some houses.

The Zirknitzen Lake in central Carniola, according to Herr Putik's description, exhibits remarkable phenomena of periodical emptying and filling. A gigantic cave, called Gilovca or Karlovca by the natives, and situated at the northwest corner of the lake, forms an outlet for the overflow. It lies at the foot of perpendicular rocks, and leads to a number of subterranean lakes, five of which Herr Putik has crossed.



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